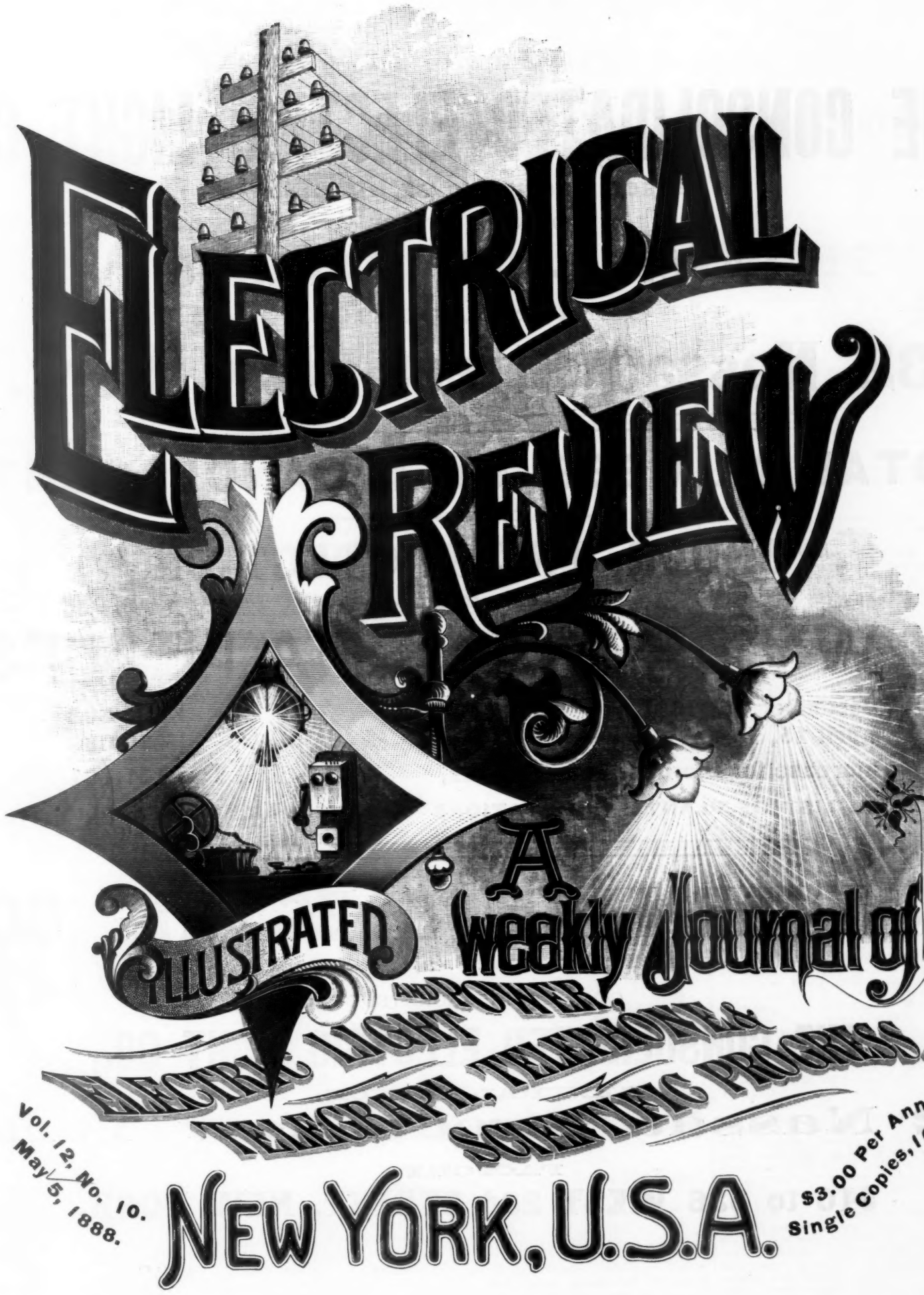

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ELECTRICAL REVIEW

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The Mather Steam Dynamo Electric Machine.

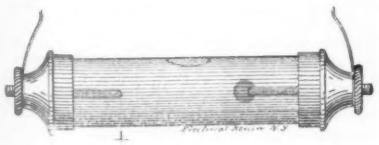
We illustrate herewith a very interesting invention just patented by Mr. R. H. Mather, of the Mather Electric Company, and the invention promises to have a wide field of application. It comprises a dynamo-electric machine having a Gramme armature in the interior of which is mounted a suitable type of revolving steam engine, so that the steam power is applied directly to the armature, instead of being transmitted through belting or connecting shafts. In other words, the driving engine is located entirely within the armature of the dynamo.

The type of engine selected is that of a three-cylinder engine, in which the three pistons receive in succession and rotate the armature in a manner which will be readily understood by referring to Fig. 2. The entire engine is contained within a steam-tight metal casing, and on the outside of this casing the armature is mounted.

On account of the necessity of boiler connections, and the consequent liability to "grounds," the inventor has introduced an insulating connection in the steam pipe near the dynamo, which entirely insulates the engine and dynamo from the boiler. The steam is taken through the shaft at one end, which is hollow for the purpose, and the exhausted steam is discharged at the other end of the shaft in a similar manner. The construction is neat, and should be very effective in practice, as it does away with all the lateral thrust of the shaft on its bearings due to the transmission of the power through a belt. The extent of space occupied is inappreciable, as the otherwise waste space inside the armature is utilized for the location of the engine, and this enables the dynamo to be placed in the most confined situations without detriment. We presume the inventor is able to apply a reliable automatic cut-off valve to his special type of engine, so that it will be economical in use under varying loads.

An Electrolytic Indicator of Polarity.

Messrs. Woodhouse & Rawson have recently exhibited a form of current indicator, which, being based on electrolysis, is entirely free from all magnetic disturbances. It has the double advantage of being small and convenient, and easy of application. As shown, it consists of a glass tube containing a transparent liquid, in which are seen two electrodes of platina, penetrating through the binding screw caps of the cylinder. Two wires are attached, and when placed in a circuit, the decomposition of the fluid produces a red discoloration around the negative pole. On being removed, the liquid again assumes its normal appearance and condition.



POLARITY INDICATOR.

It can be used repeatedly for a current having an E. M. F. as high as four volts, and is a very pretty piece of experimental apparatus; but for heavier currents it is difficult to find a better method than that in which the compass plays so important a part. Where the wire conveying the current lies in a nearly east and west line, a small magnet may be made to deflect the needle into an artificial magnetic meridian, and Ampere's rule will tell the story as plainly and truly as if the wire was in the actual magnetic meridian.

The Electric Motor Man.

The energy and patience and determination of the electric motor man is becoming recognized. At the office of the Newark Electric Light Company four chairs, labelled with the names of as many different motors, can be seen arranged in a row and every time a motor man arrives he is compelled to occupy his assigned chair. The chairs are said to be seldom vacant and quite often all four are occupied.

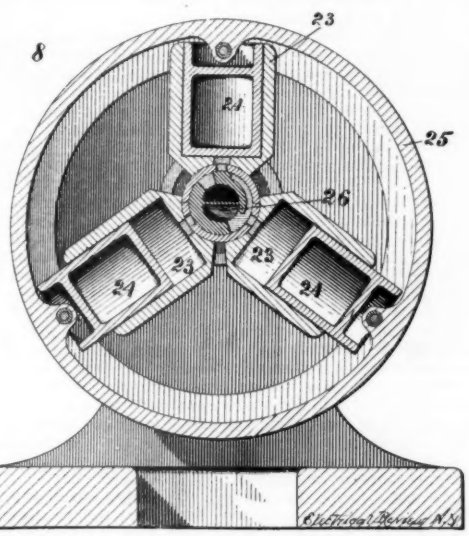


FIG. 2.—DRIVING ENGINE OF ARMATURE OF MATHER STEAM DYNAMO.

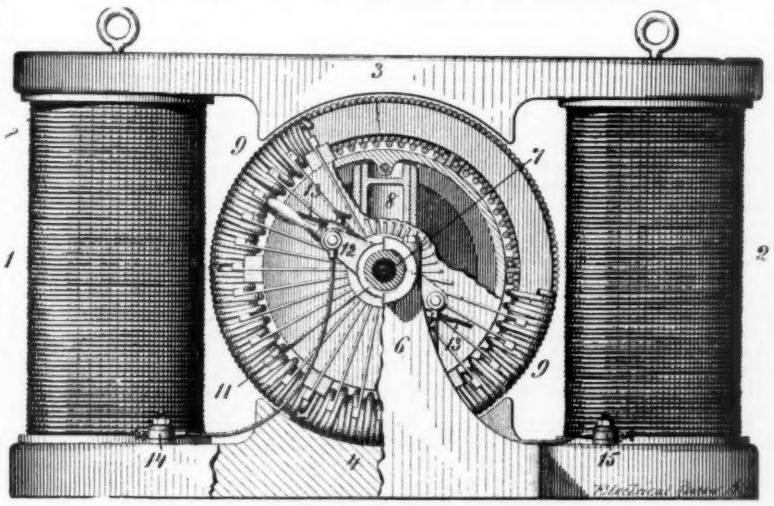


FIG. 1.—MATHER STEAM DYNAMO.

Electricity for Tempering Watch Springs.

Another use for electricity is in the tempering of watch springs. By the old method the steel wire, from which the springs are made, was heated to the proper temperature, and immediately plunged into oil. In the new process the wire is immersed in the oil bath first, and is then brought, by means of an electric current, to the desired degree of heat. It is claimed that in this way a more even temperature can be obtained, and that the difficulties arising from the formation of oxide on the surface of the steel between the stages of heating and immersion are entirely obviated.

The Telephone Decision Interpreted.

WHAT U. S. JUDGE BREWER SAYS ABOUT IT IN GRANTING AN INJUNCTION ASKED FOR BY BELL.

In the case of the American Bell Telephone Company against the Southern Telephone Company, at Little Rock, Ark., U. S. Judge Brewer gives the following able and interesting decision:

When I came here I did not expect the burden of this case to fall on me, but thought I had only come to assist my brother Caldwell here and simply to advise with him. But the circumstances were such when I arrived that it seemed necessary that I should take the sole responsibility, and that he should look after other matter pending, aside from this case. I did not want to take the case. I avoid patent cases all that I can. And yet this happened to be one of those cases involving questions to which my attention has been directed as a matter of intellectual interest for the last two or three years, and from time to time as the opinion of the various courts have been announced I have examined each opinion and studied it with interest and curiosity as to the various questions presented and passed upon.

When this bill was filed no decision had been announced by the supreme court of the United States, although several opinions have been promulgated by several circuit courts, and so a good deal of the testimony taken and presented in this cause was with reference to matters which it was apparently thought might be presented for examination here. But on the 19th of last month the supreme court decided the question, and that decision puts out of consideration many matters that would otherwise be fair subjects for discussion.

Of course the decision in that cause is not a final adjudication as between these parties. The proceeding there was *res inter alias acta* and not conclusive upon this litigation. Many questions of fact which, as between those parties, were settled by that decision—such as the question as to the priority of discovery—are not settled as between these parties by that decision. That question is still so far open that when that court has a new case before it, if brought between other parties and upon different testimony, it may declare that Mr. Bell was not the first discoverer and inventor. Thus the supreme court about two years ago, after a careful investigation, sustained what is known as the "Driven well" patent, but in the next year the court declared that patent void because the testimony showed the entirely new fact of two years public use which was not in the first case. Some years ago I sustained the Glidden patent for the barbed wire fence, and it is the only patent I ever sustained. Afterwards Judge Shiras held it bad because of a prior use and invention not shown in the case before me

But it unquestionably appears from the decision of the supreme court that they upheld Mr. Bell's patent, and after carefully considering its construction they gave it a very broad scope. In cases even between other parties which come before the courts, certainly on motions for preliminary injunctions, that decision must be accepted as conclusive unless perhaps there should be developed unexpectedly a clear showing of new matter. If, for instance, in this case there was presented to this court something which was absolutely new in this litigation, something that was very clear and conclusive, clearly proved beyond question as a matter of fact and entirely conclusive in its effects, then this court might refuse an injunction, notwithstanding the decision of the supreme court affirming the validity and determining the scope of that patent. But in all ordinary cases on an application for a preliminary injunction the decision of the supreme court must be accepted as conclusive, both as to the validity of the patent and as to the question of the scope or the extent to which the patent goes. That relieves me of much labor.

I understood the counsel in their argument to state that from previous decisions it must have been expected, and that it was expected by the profession generally, that the supreme court, if it found against the validity and priority of Mr. Drawbaugh's claim, would sustain the Bell patents as broadly sustained as they have been sustained. This may have been the expectation and belief of the bar in the east, but I am inclined to think from the discussions by several members of the bar who have given this matter investigation, that that was not the expectation here, and that the belief was that if the patent was sustained and Mr. Bell decided to be the first who made the invention, the patent would be so

limited in law as to make it a patent for the particular apparatus described or for the particular and limited mode which was embraced and developed in the precise apparatus shown. But I think no man can read this opinion of the supreme court and no man can compare that opinion with other deliverances of the courts upon patent cases without perceiving that, in language as clear and potent as it is possible for language to be, the court has affirmed the validity of the patent, and has decided its scope without limiting it to the mere apparatus, and have held that it extends to his whole method of reproducing vocal sounds. I believe that his method as he states it in his patent, and as the supreme court construes it, covers the whole matter of the telephonic transmission of speech, because the essential part of it consists in the transfer to the electric current and the transfer by that current of the vibrating motions caused by the human voice in the utterance of speech.

Let me turn now to the opinion. The chief justice says: "The important question which meets us at the outset in each of these cases is as to the scope of the fifth claim of the patent of March 7, 1876, which is as follows:

"The method of and apparatus for transmitting vocal or other sounds telegraphically as herein described, by causing electric undulations, similar in form to the vibrations of the air accompanying the said vocal or other sounds, substantially as set forth."

That is the idea of the transmission of these sounds by means of electrical undulations which are "similar in form" to the air vibrations that constitute the sounds to be transmitted. The court continued:

"The question is not whether 'vocal sounds' and 'articulate speech' are used synonymously as scientific terms, but whether the sound of articulate speech is one of the 'vocal or other sounds' referred to in this claim of the patent. We have no hesitation in saying that it is, and that if the patent can be sustained to the full extent of what is now contended for, it gives to Bell, and those who claim under him, the exclusive use of his art for that purpose, until the expiration of the statutory term of his patented rights.

"In this art—or, what is the same thing under the patent law, this process, this way of transmitting speech—electricity, one of the forces of nature is employed; but electricity, left to itself, will not do what is wanted. The art consists in so controlling the force as to make it accomplish the purpose. It had long been believed that if the vibrations of air caused by the voice in speaking could be reproduced at a distance by means of electricity, the speech itself would be reproduced and understood. How to do it was the question.

"Bell discovered that it could be done by gradually changing the intensity of a continuous electric current so as to make it correspond exactly to the changes in the density of the air caused by the sound of the voice. This was his art. He then devised a way in which these changes of intensity could be made and speech actually transmitted. Thus his art was put in a condition for practical use.

"In doing this, both discovery and invention, in the popular sense of those terms, were involved; discovery in finding the art, and invention in devising the means of making it useful. For such discoveries and such inventions the law has given the discoverer and inventor the right to a patent—as discoverer, for the useful art, process, method of doing a thing he has found; and as inventor, for the means he has devised to make his discovery one of actual value. Other inventors may compete with him for the ways of giving effect to the discovery, but the new art he has found will belong to him and those claiming under him during the life of his patent."

That is, the intensity of the current was changed in accordance with the form or character of each vibration. And then again the language of the court implies, what seems to me from my study of the telephone to be a necessary physical fact, that in no other way can electricity be actually made operative to convey those peculiar vibrations. That is the main idea of the patent. There must of course be something more than the bare idea; there must be some machine to make it practically useful, but the patent is not limited to the employment of it by that particular apparatus. The court said:

"An effort was made in argument to confine the patent to the magneto instrument, and such modes of creating electrical undulations as could be produced by that form of apparatus, the position being that such an apparatus necessarily implied, a closed circuit incapable of being intermittent. But this argument ignores the fact that the claim is, first, for the process, and, second, for the apparatus.

"It is again said that the claim, if given this broad construction, is virtually 'a claim for speech transmission by transmitting it; or, in other words, for all such doing of a thing as is provable by doing it.' It is true that Bell transmits speech by transmitting it, and that long before he did so it was believed by scientists that it could be done by means of electricity, if the requisite electrical effect could be produced. Precisely how that subtle force operates under Bell's treatment, or what form it takes, no one can tell. All we know is that he found out that by changing the intensity of a continuous current so as to make it correspond exactly with the changes in the density of air caused by sonorous vibrations, vocal and other sounds could be transmitted and heard at a distance. This was the thing to be done, and Bell discovered the way of doing it. He uses electricity as a medium for that pursose, just as air is used within speaking distance. In effect he prolongs the air vibrations by the use of electricity. No one before him had found out how to use electricity with the same effect. To use it with success it must be put in a certain condition. What that condition was he was the first to discover, and with his discovery he astonished the scientific world."

Then the court quotes from some of the scientific commendations and adds: "Surely a patent for such a discovery is not to be confined to the mere means he improvised to prove the reality of his conception."

It follows, and this to my mind is supreme as to the scope of the patent, that by its terms and by the decision of the court it covers, the idea of the transmission of the vibrations of articulate sounds by undulatory currents of electricity.

These undulations or vibrations are the means of reproducing human speech at a distant point, because they repeat electrically the same vibrations The sound vibrations are, so to speak, converted into corresponding and similar vibrations of electricity, as though these forces of nature, though different, were convertible, and what was done by the one would be, and in the telephone were copied by the other. The idea was that when the vibrations created by the organs of speech acted on the electrical current they set up in the electrical force the same variations or vibrations, transferred these vibrations to the electricity, which in turn transferred them to the distant point. That is the idea on which Mr. Bell's instrument is based.

The difference between putting into the current of electricity undulations which are copies of the vibrations caused by the human voice, and using a regular and uniform current of electricity merely broken up by intermissions, or what is called a make-and-break, as it is expressed, is very clear. Take the old Morse instrument. In that the currents of electricity are uniform; they are merely made and broken, and there is nothing like any change in strength. Suppose we load each barrel of a revolver with a bullet of the same size, density and shape, and shoot one after the other, they impact upon the object on which they strike with successive blows which are uniform, systematic and regular. When a current of water flows through a pipe, if we suddenly turn a stop-cock, we simply break the current; as soon as it is opened and the water gets going, it flows again with a uniform motion, and this makes only a similar impression upon a far-off object.

But Bell's idea of the transmission of sound is that the vibrations are irregular and different for each word, somewhat as if you put a paddle in the water and wave it backward and forward irregularly. Then the wave-like motion of the water is like that of the paddle. That is Mr. Bell's idea. The wave-like changes in his current are irregular, just like the irregular to and-fro movement in the air which produces his electrical waves. That is what the supreme court says his patent is for. He takes a current of electricity, which is uniform and regular, and continuous in its flow, and changes that current by the vocal impulses, such as are made by articulate speech, so that the current, instead of being simply continuous and uniform, corresponds exactly with the variations of the vibrations in the air.

Looking at it from that standpoint, it seems to me impossible to transmit human speech by electrical currents otherwise than by giving to those currents variations harmonious with and corresponding to the various vibrations of the air. It would be impossible to do it by sending regular and uniform currents merely broken up. If you should merely break up a uniform current, preserving its uniformity, it would be a physical impossibility ever to transmit speech by means of it; for it is a physical impossibility ever to transfer human speech otherwise than by getting the current itself to correspond to the peculiarities of the vibrations which constitute that speech, and which the current must transfer.

That there is in all articulate speech something that may be called a pause between one vibration and another, and that that infinitesimal pause will cause a corresponding instant of no motion or no change in the electrical current which transmits that speech is obvious. When I speak there is not in one sense an unbroken and continuous flow of sound. In every vibration of the air there is an instant when, having moved in one direction it ceases to do that and begins to move in the other; and so in an electric current which copies that vibration, there would be the same corresponding infinitesimal break and flow again. And besides that, between each sound or between each word or each syllable there is a pause in the air vibrations, and so there would be in the electric undulations which copy them. But there is not a broken current like the current of the Morse telegraph. When we speak of a continuous current in the telephone we mean a current which has such continuity as the air vibrations and motions have in speech.

It was urged at the hearing that the defendant's instrument had breaks of current which accompanied the various changes in the motion of the instrument acted on by the voice. It was said that the use of the induction coil showed that there were breaks in the currents, and also that there were two separate circuits, the primary and the secondary, and that the current did not flow and was not continuous from one into the other. Neither of these considerations are new in this litigation. Both were presented to the supreme court. But suppose all that to be true, just as stated. If the supreme court had decided that there must be only one current, and that the current must be absolutely continuous, there might perhaps be force in that contention. But the idea which the supreme court rested on was that of a current continuous and undulating in the sense in which I have described it, like the vibrations of the air, corresponding to its motion, and not "merely" intermittent. It would not make any difference, in my opinion, if there were half-a-dozen currents cooperating with each other so that the transmitting current took up the undulations corresponding to the air vibrations and carried them to the distant point. The idea expressed by the supreme court is that stated by the language of the specification—causing and employing electrical undulations "similar in form" to the air vibrations accompanying the vocal or other sounds to be transmitted. That is the idea. That is the art or method which is patented; the same variations in the electricity as in the air—similar to the changes in the air vibrations, and coextensive with them.

To one who has read this opinion of the supreme court, with that view of the operation by which speech is transmitted, there can be but one conclusion as to the fact that the various instruments which are used and are said to be used by these defendants infringe. Whatever else they do or do not produce, they produce electrical changes which correspond to the vibrations and sound waves caused by articulate speech, and those are the "undulations similar in form to the air vibrations," described in the patent.

Thus far I have very little trouble in reaching a view which disposes of this part of the case.

The other question is one that is more embarrassing, and that is whether a preliminary injunction under the circumstances of this case would be proper. These defendants engaged in this enterprise in the summer or fall of 1885. This suit was brought in the fall of 1887. For two years before this suit was instituted, the defendants had been in operation and had built up a business of some 400 telephones. The fact that it had established or was establishing its business was well known to the Bell company, and still no suit was instituted for a period of two years. Under these circumstances two questions arise.

Generally a doubtful question of fact ought not to be settled on exparte affidavits. In this application for an injunction the case is presented on both sides by affidavits, and affidavits are not very reliable testimony. The case, it is urged, ought to wait until the witnesses could be examined and cross-examined, and only after that full investigation, which is more certain of eliciting the truth, ought an injunction to be issued. At the hearing the important question which the counsel relied upon as doubtful, was whether the process by which their instruments transmitted speech, consisted in the use of undulatory waves, or of the absolute make-and-break of a current which was uniform between the breaks, and they urged that that question ought not to be settled on a preliminary investigation, or by any means short of a full hearing, upon the examination and cross-examination of witnesses.

Where there is a doubtful question of fact the court will generally wait until witnesses have been produced and been examined and cross-examined. And if this case was a case which turned upon the weight to be given to the testimony of witnesses on such a subject, the argument would be forcible.

Suppose that I entered possession of a tract of real estate, and having left it came back twenty years after, and upon the question of an injunction, the defendant claims a continuous occupation, and I produce affidavits and he produces affidavits as to whether there was actual entry and possession by each twenty years ago. That presents a question that in the very nature of things may be doubtful, and affidavits on such a matter may control the courts very little. This is a question that particularly presents a subject for cross-examination of the witnesses. But I have had enough experience in patent cases to know there never was a patent of any intricacy in which experts could not be produced on either side—men of intelligence and scientific acquirements, ability and integrity who would file their affidavits on one side or the other. But no amount of that kind of evidence as a rule will overcome what the court can clearly learn from an intelligent examination of the instruments themselves. The examination of those instruments with the explanations given by Mr. Young and Mr. Storrow, on one side and the other, in regard to the respective apparatus, is testimony that is full and competent in this case. You see the instruments, and you examine them to ascertain the process with the explanations of these gentlemen, who are fully competent to understand it. This is not a case where the investigation is surrounded with doubtful questions of fact, which could be cleared up by cross examination of the witnesses.

Another argument urged against this motion is that a man who claims land upon which he sees his neighbor trespassing, and on which he sees his neighbor expending money, believing that it is his own, and lets him go on without opposition, may lose his right to a preliminary injunction. A man who stands by and sees his neighbor go onto his land and dig a cellar and put in a foundation and build a house, and waits from day to day, and month to month, and year to year and says nothing to restrain him from the use and waste of his money, and afterwards wants to turn round and take his money and the products of his labor and time, does that which shocks any man's sense of right. If he knew this man was using his time, labor and money to improve his property, he should have tried to restrain him; then if the trespasser still persists, it is the trespasser's own fault.

The defendants claim that the plaintiffs did not bring their suit until two years after the defendants built their exchange, and that is the fact. But no definite length of time constitute laches. This defence always depends upon the circumstances of the case. If these defendants had proceeded to make their investment, believing that they had a right to use their telephones and believing that no claim was made to the contrary; and had been led into this condition, by inaction and silence on the part of the plaintiffs with full knowledge of what the defendants were doing, of course it would be unfair to stop them now before the case is tried in the usual way.

But in this case the fact that Mr. Bell had these patents, and that he was insisting upon his claims in the broadest extent, and as broadly as he does now, and was carrying on the litigation in several courts of the United States, and that several courts in the various circuits had confirmed its validity and its scope as he contended for it, and that a number of these cases were pending in the supreme court of the United States, and that most earnest and vigorous proceedings were being carried on by the Bell company to enforce its claims, and that one department of the government was affirming fraud in the patents, and was about to institute proceeding for the purpose of cancelling the patent—these matters were of common knowledge. But the defendants, in the face of those universally known facts, and it is proved with actual knowledge of the existence of the litigation and the decisions, and of the fact that litigation was pending in the supreme court of the United States which would sooner or later be determined, entered into this business. They say they believed that the patent would be decided to be void, and that they believed that the government suit would be a protection; and I have no doubt they believed this.

If the patent had been defeated in the supreme court there would be no injunction and they would be free. But this was one of the matters to be determined by the court of last resort. Under those circumstances can it be said, when these suits were finally determined in the supreme court and Mr. Bell was sustained to the fullest extent claimed by him here, that he should be answered here by the claim that as he had waited until his rights were determined, he was too late to enforce them; and because the defendants had infringed for two years during the litigation they were watching, they should not be interfered with for six months or nine months, or some other time afterwards. It is the case where, to use a common phrase, a man buys into a law-suit and must take his chances of the result. For here the defendants knew all about the litigation and what the consequence of a decision by the supreme court must be, and based their expectations on the belief that the litigation would terminate adversely to Mr. Bell. But it has ended in his favor.

This case is of much importance, and I have heard several days argument on the motion and given it all the consideration possible during the whole week. It is evident from what has been said that the plaintiffs are entitled to the preliminary injunction asked for, and it is granted.

Akron, Ohio.—A company with a capital of $300,000 has been formed at Akron, O., for the manufacture of hard rubber.

Paterson, N J.—The Connelly Motor Co., Paterson, N.J. Capital, $1,000,000. Thomas E. Connelly, and others, incorporators.

Sioux City, Iowa.—The Sioux City Electric Co. has been incorporated. Capital, $50,000. E. W. Rice, and others, incorporators.

Pittston, Pa.—The Citizens Electric Illuminating Co. has been incorporated. Capital, $40,000. K. J. Ross, and others, incorporators.

Columbia, S C.—The Congaree Gas and Electric Co. has been incorporated. Capital, $25,000. J. T. Sloan, and others, incorporators.

Chicago, Ill.—The Park Manor Light and Heat Co. has been incorporated. Capital, $5,000. Thomas P. Keefe, and others, incorporators.

Gloucester, Mass.—The Gloucester Electric Co. has been incorporated. Capital, $20,000. William H. Jordan, and others, incorporators.

Hastings, Minn.—The Hastings Electric Light and Power Co. has been incorporated. Capital, $15,000. J. T. Putnam, and others, incorporators.

Wakefield, Mass.—The Wakefield Electric Light and Power Co. has been incorporated. Capital, $10,000. George H. Maddock, and others, incorporators.

Gloucester, Mass.—The Electric Light Company, Capital Stock $20,000; Wm. H. Jordan, prest., Joseph O. Potter, treas., Wm. Thompson and Francis Proctor, directors.

Springfield, Ill.—The Chicago Fire-Proof & Insulating Company of Chicago; capital, $100,000; incorporators Marshall B. Hugheson, H. C. Lincoln, John Bouchard and H. C. Lazelle.

Springfield, Ill.—A certificate was filed to record the increase of the capital stock of the Niagara Falls Hydraulic Motor & Power Company of Chicago, from $15,000,000 to $50,000,000.

Alexandria, Vt.—The American Telephone Co. (consolidated) has been charted to manufacture telephones, telephone supplies, etc., erect electric light and power plants, etc. The capital stock is stated to be not less than $7,000,000.

Russell, Kan—A charter was filed last week for the Russell Electric Light and Power Company, with a capital stock of $10,000; directors, J. M. Brandage, S. E. Lawson, W. H. Moses, A. T. Brooks, Chas. A. Wolcott and J. H. Hill of Russell.

Indianapolis, Ind.—The Worthington Engine Manufacturing Company filed articles of association in the Secretary of State's office. Capital stock, $40,000. The directors being C. H. Roberts, Z. F. Graham and F. K. Denver. In addition to the manufacture of engines it will do a general repairing business.

Kittery, Me.—The Tebbetts Rolled Forging and Machine Company organized at Kittery with a capital stock of $500,000. The stockholders are Samuel Disston, Philadelphia, Penn.; Chas. F Tebbetts, Fitchburg, Mass.; Calvin B. Tuttle, Lynn, Mass.; Henry O. Strattan and Robert B. McKim, Boston, Mass. Charles F. Tebbetts is president, Henry O. Strattan, treasurer, and Henry O. Strattan, Charles F. Tebbetts and Calvin B. Tuttle are directors.

London, Eng.—The Julien Electric Company, Limited, has been organized in London, with a capital stock of £100,000 shares, £10 each, to purchase the British patents, viz: 1885, No. 8881, improvements in secondary batteries, part of which is applicable to primary batteries; 1886, No. 2470, for improvements in electrical locomotion, propulsion or traction, and the apparatus therefor; and also the benefit of an application for letters patent 1887, No. 8855, for improvements in and appertaining to electric piles and plates therefor; to carry on the business of manufacturing or dealing in engines, machinery and other things which are manufactured or used in accordance with the inventions.

The Electric Light in Honolulu.

The Thomson-Houston Electric Company has received a very interesting letter from Mr. W. A. Faulkner, Superintendent Government Electric Lights, Honolulu, regarding the Thomson-Houston plant which has been installed there.

No time was lost in setting up the engines and dynamos after their arrival, and on March 23d the city was illuminated for the first time by the electric light. Honolulu, the principal city of Hawaii, is peculiarly well situated for electric lighting on account of the water supply which can be easily utilized for generating the necessary power. Their station is situated 2½ miles from the centre of the city, and is about 400 feet above the sea level.

Water power at the station is derived from a 300-foot head, carried through 5,296 feet of pipe 15 inches in diameter, and there is a pressure of 130 pounds to the square inch. This is a part of the city water supply, doing its work at the station on its way to the reservoir. The power is supplied by a double discharge mining wheel 20 inches in diameter, making 1,250 revolutions per minute, at the pressure above mentioned. This wheel drives two dynamos, both manufactured by the Thomson-Houston Electric Company, one of 12 and the other of 50 light capacity; the smaller machine carrying its lights on 6 miles of wire, and the larger on 15. Both machines have worked admirably, and have given from the start every satisfaction.

On the 23d ult., the day of starting, a distinguished company assembled at the station, amongst whom were her royal highness Princess Kialani, heiress presumptive to the throne, and his excellency L. A. Thurston, Minister of the Interior. The princess, under the direction of Mr. Faulkner, completed the circuit, and had the honor of lighting the city for the first time with the new lights.

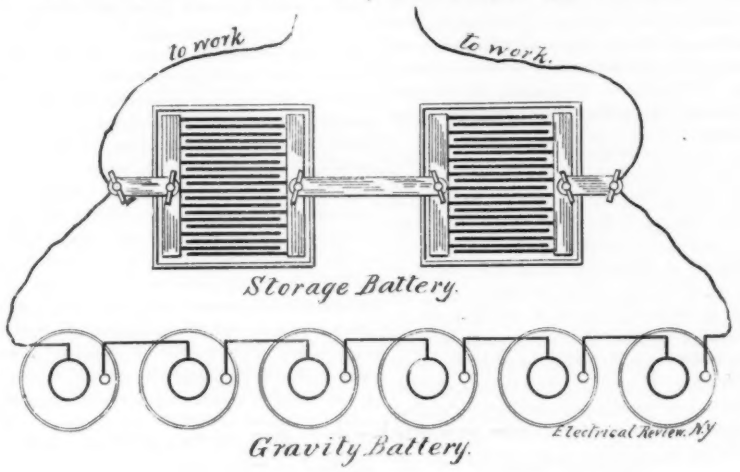
The start was most successful, every lamp burning. The scene in the city was very exciting, the streets being thronged with people, many of whom had been waiting for some time to see the lights turned on, and who all appeared very much pleased with the result. The lights have been lighted every night since, and the installation has been a most successful one in every way.

The members of the government were so much pleased with the operation of the plant that it is more than probable that the present system will ere long be extended.

Mr. Faulkner adds that, "in conclusion, let me again say that the goods supplied by your company have given great satisfaction, and the way in which the dynamo works and the steady brilliancy of the lamps have been the subject of general remark."

"C. & C." Gravity and Storage Battery.

We illustrate in the diagram herewith a very ingenious and useful application of the storage battery, recently brought out by the "C. & C." Motor Co. Their object is to avoid the use of bichromate solutions and the annoyance of renewing the same at frequent intervals. Their new apparatus consists of two moderate sized storage cells coupled in series to the motor—which is generally intended for use in driving sewing machines and other similar purposes requiring small power. To the terminals of the storage battery, as indicated in the diagram, are connected the terminals of a battery of six ordinary gravity cells arranged in series as shown. The connections are permanent so that the gravity battery is always working on closed circuit, and may therefore be easily kept in its very best and most efficient condition. The gravity battery thus arranged will seldom need attention, and may therefore be placed in the cellar or other out-of-the-way location. The storage battery can be kept near the point of use and will not need any attention whatever, and can therefore be locked up if necessary. We understand this is meeting with great favor and it evidently deserves it.



The Case Against the Southern Telephone Company.

The writ of injunction was served on the Southern Telephone company's officers last week, restraining them from using or furnishing for use, any speaking telephones, but by consent they may continue the use of them until May 1, and by consent it was ordered that the defendants plead or submit therein by June 1.

The Southern has about 500 instruments in use in Little Rock, but the result of the suit now gives the Erie (Bell) a monopoly of the business. It is estimated that the plant of the infringing company cost $53,000. The stock is all owned by Little Rock parties The directors of the company are F. T. Vaughn, George W. Caruth, Jacob Erb, W. B. Worthen and E. W. Parker.

The case was well presented by Hon. J. J. Storrow, of Boston, Judges John McClure and E. W. Kimball, for the plaintiff; Hon. Casey Young, of Memphis, Hon. Jeff Chandler, of Washington, and Messrs. U. M. and G. B. Rose, and Caruth & Erb for the defendant.

—— The San Diego, Cal., Electric Rapid Transit Street Car Company is to be extended to Twenty-first street, to B, and out B to Thirtieth.

—— The town authorities of Farmingham, Mass., have given a contract to the Electric Light Company, to furnish fifty arc lights at $100 per year.

—— Col. Howland has begun in Los Angeles the erection of a two-story brick building, 100x100 ft., to be used for the generation of electricity for motors, etc. Two 500 horse-power engines will be used.

—— The Central Railroad Co. of Davenport, Iowa, have given the Sprague Electric Railway and Motor Co. a contract for their system, by which light cars are to be supplied. The cars are to be lighted by incandescent lamps.

A New Compound Condensing Engine.

The Westinghouse Machine Company, of Pittsburgh, appreciating the great desirability of the economical generation of power, have been for a long time experimenting, with a view to bringing out a special type of compound engine as adapted to their peculiar form of engines Several rather complex problems had to be solved in order to produce an engine which, while maintaining the peculiar features of their ordinary high pressure engines, would also be capable of the economical performance of compound engines, without the introduction of any more complexity in the mechanism for starting or controlling their operation, and without surrendering any of the advantages of automatic regulation under varying steam pressures and loads. The result has been attained, and they are now about to introduce upon the market a complete line of compound engines of both the condensing and non-condensing type, in sizes from 5 to 600 horse-power, all of which will possess the advantages, so well and favorably known, of their regular standard high speed engines. We append the data of a few sizes of the engine in its two types, condensing and non-condensing compound engines. We also append a few figures tabulating the result of a series of tests giving the water rates per brake horse-power at varying pressures and loads by which the very meritorious performance of the new engines will be readily apprehended.

Horse Power.		Stroke	Diam.	Diam.	Speed
Cond'g	Non Cond'g		H. P. Cyl.	L. P. Cyl.	
6	5	4 in.	4 in.	6 in.	500
12	10	5 "	5 "	8 "	450
30	25	7 "	7 "	12 "	390
60	50	9 "	9 "	15 "	350
120	100	12 "	12 "	20 "	300
300	250	16 "	18 "	30 "	250
600	500	20 "	25 "	42 "	210

WATER RATES, PER BRAKE, H. P.

	CONDENSING.				NON-CONDENSING.			
Brake H. P.	Boiler Pressure.				Boiler Pressure.			
	120	100	80	60	120	100	80	60
200	19.6	22.5			23.9			
160	18.8	20.0	23.1		23.5	25.2		
130	18.3	19.5	21.3	24.3	24.3	26 2	27.7	
100	19.1	19.4	20.3	23.1	25.5	27.7	29.8	
70	19.	20.0	21.4	22.5	29.4	28.3	29.8	36.0
40	22.	23.1	24.7	25.2	40.0	39.3	42.7	45.8

Unjacketed and uncorrected by Calorimeter.

Personals.

Mr. J. A. Powers and his father were visitors from Troy last week. They are at the head of the electric light company in that city.

Prof. F. B. Badt, formerly of Chicago, has decided to make his home in New York, and will have his headquarters at 120 Broadway.

Mr. Fred. H. Whipple, the author of "Municipal Lighting"—which will appear at an early day—is in the East in the interest of his book.

Gen. O. E. Madden and Mr. H. L. Storke paid a flying visit to Chicago last week, looking after one of the suburbs of that village, of which Mr. Storke is the pleased proprietor. Mr. D. I. Carson, of New York, was a Chicago visitor the same week.

Mr. S. E. Barton, of Boston, well known in both insurance and electric lighting circles, was a cheery REVIEW visitor last week. Mr. Barton is a strong believer in the electric light as a safe illuminant, and has accomplished a great work in this direction among the insurance interests.

Mr. Stephen Holbrooke, well known in electric light circles, has accepted the general managership of the Central Auxiliary Fire Alarm Company, with headquarters in the Bullitt Building, Philadelphia. The Auxiliary has made a wise choice in selecting a gentleman of Mr. Holbrooke's acquaintance and ability, and he will undoubtedly win great success in this field. He still retains an interest in several local electric lighting companies.

—— Gloucester, N. J., has contracted with the Philadelphia agent of the American system for an arc plant of seventy-five lights; work will be commenced at once and the lights running by June 1st.

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Address all communications and make all Express Money orders, P. O. orders and checks payable to order of ELECTRICAL REVIEW, P. O. Box 3329, New York.

☞ No attention will be paid to communications without the *name and address of the writer.*

We invite correspondence from Electricians, Inventors, and the Telegraph and Telephone fraternity and those engaged in Electric Lighting, on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

Subscribers can at any time have the mailing address of their paper changed by sending both old and new address.

Timothy W. Sprague, Massachusetts Institute of Technology, is our representative at Boston, Mass.

Mr. C. C. Haskins, 118 La Salle Street, Chicago, Ill., represents the REVIEW in the West.

NEW YORK, MAY 5, 1888.

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Electric motors are very properly suggested as a means sure to promote the efficiency of every day operations on board war vessels.

The Mather steam dynamo is a move in an important direction. One of its most fitting adaptations will be for shipboard use.

The *Locomotive Engineer* is a recent publication of interest and value. It covers the field its title indicates most thoroughly. Mr. Horace B. Miller, the able head of the *American Machinist* is the publisher, and his great success with the *Machinist* will no doubt be duplicated in the *Engineer*.

It is about time that curious people learned the motto which, as in the Scotch thistle, lies hidden in the electric light wire: "*Noli me tangere.*" But curiousity is hard to deal with, both in man and beast. Who ever saw the sign "Paint!—don't touch," unaccompanied by the thumb or finger signs of the doubting Thomases?

Gen. W. F. Draper, the newly elected president of the Thomson Electric Welding Co., has formally announced his candidacy for the gubernatorial chair of Massachusetts and now discreetly departs for Europe, and thereby avoids the personal annoyances of newspaper comments and editorial discussion. He sails on Wednesday from New York and will probably be absent about four months.

A young clerk in this city reached up and took hold of an arc lamp; he received a severe shock and death resulted. This will give our daily contemporaries another opportunity to discuss and exaggerate the dangers of electricity. Had the man placed his hand on an active buzz-saw, or laid down in front of a moving locomotive and had his life crushed out, it would have been called carelessness or suicide. It is a very difficult thing to provide complete protection for that class to which the above careless individual belonged.

The connection that Mr. Alfred Vail, of New Jersey, had with the development of the electric telegraph is given at some length in another column. There is little need of comment. Mr. Vail deserves high praise and we gladly accord it. With the exception of Prof. Morse, he probably did more than any other individual towards perfecting and introducing the telegraph. Yet we can never forget that it was Prof. Morse that conceived the idea of the telegraph, and had it not proven a great success we doubt if any other name than his would have been associated with it.

WILD TALK.

The remarks of the usually reliable *Herald*, published elsewhere, are not only seditious, libelous and contemptibly lawless, but display an utter disregard of the property of one of the greatest commercial interests of the day.

It is daily proven that electrical illumination is many times safer than any method of giving artificial light yet employed since the days of the tallow candle, which our contemporary may be wedded to still.

We did not expect to see such dense ignorance and bigotry displayed in a journal of the *Herald's* standing.

DECLARED TO BE INFRINGERS.

Judge Don. A. Pardee of the United States Circuit Court at New Orleans, last week, rendered a decree on final hearing in the case of the American Bell Telephone Company *et al vs.* The National Improved Telephone Company in equity. The court decides that the telephones used by the defendants are an infringement on the Bell patents, and orders that all such instruments be delivered to the clerk of the court, subject to further orders, and gives the complainants judgment against the defendants for all costs, charges and disbursements in this suit. William Grant is appointed master to ascertain costs and damages. This just about effectually kills telephone infringement in the South.

THE UNDERGROUND PROBLEM.

Our wide-awake and ever vigorous contemporary, the New York *Herald*, thus attacks the electric lighting companies of this city:

"We are the most patient people in the world or we wouldn't stand this nonsense another hour. If we were just to ourselves, we should instantly compel these companies to properly insulate their wires or take them down. Expense? What of it? If it throws the whole concern into bankruptcy, that is no more than it deserves. Let it go to everlasting smash and be done with it, and then when another concern comes to the front it will use more care, and we shall have fewer funerals.

"Mayor Hewitt says he is powerless. Well, we are sorry. But we can safely assure His Honor that if he wants the authority or the money to bury these unsightly and dangerous wires he can have both. The time for dallying with this matter has gone by. There is no excuse for so palpable a neglect of duty."

But we would remind our neighbor that every question has two sides at least, and this summary method of solution seems very vague when viewed all round.

The electric lighting companies would be only too glad to bury their wires if the Board of Electrical Control will give them a system which answers the requirements. It has not, to our knowledge, been a question of cheapness solely, though that has been an element in rejecting some of the wildcat schemes proposed. Suppose to-day, all lines now in use were buried in underground conduits. Is it not a palpable fact that the wires must come above ground to each and every arc lamp in the city? Can the *Herald* suggest any way of supplying the current without doing that? So far as danger from wires at the lamps is concerned, it does not avail to bury the trunk lines and then carry the local lamp wires up to the lamps; this rather increases than diminishes the complexity of the problem. And after all, without going into a scientific discussion of the various arguments for and against, would it not be well to take a broader view of this whole question, and leave the solution to those best qualified to work it out? There are grave difficulties to be overcome, and the telephone, telegraph and electric light companies in this and many other cities have spent and are spending vast sums of money to accomplish the successful undergrounding of the wires. Their efforts should not be ignored, and a magnificent benefit to humanity throttled almost in its birth, because some accidents have happened. In many of these cases the result has been clearly due to carelessness or foolhardiness, and if employés and others will persist in "playing with fire," in spite of all warnings to the contrary, they alone are to blame.

Accidents have, it is true, befallen blameless people, but how many? And how many people are killed or maimed in our midst by reckless driving, negligent contractors, street cars, railway cars, and gas? Yet are we to stop all driving above ground, all car traffic, all building? Are we to say gas must go, because, though it is carried underground, it breaks loose now and then and suffocates somebody?

The *Herald* no doubt has felt thrills of compassion for one or another of its pressmen who have carelessly got their fingers or hands crushed in the gearing of its monster presses.

Therefore, it should put the presses out of reach. Then how would it get the paper out?

The Italian Electrical Society has offered a prize of 600 francs for the best work on electro-magnets, with especial reference to their application to dynamos.

Bare electric wires could with safety be run through powder in bulk, and a heavy current transmitted, provided the conducting wires were large enough to carry the current and remain cool.

The Brush Electric Light Company of Detroit have made a motion for a new trial in the case of Almeron Kraatz, who recently obtained a verdict of $10,000 against the company for injuries received while trimming tower lamps.

OUR CHICAGO LETTER.

(Special Correspondence.)

The San Jose and Santa Clara Railroad Company has had bad luck with its electrical experimenting. It thought to use a system, which, for some reason or other, failed to accomplish the required hauling of the people over about five miles of street railway, and the San Jose folks are uncomfortable thereat. A lack of harmony between the construction company and the electrical branch of the firm resulted in the ignoring of the former by the latter, and the final abandonment of the field by the last-named factor in the combination. The owners of the railroad, according to a correspondent, are indignant, not at the amount of money which they claim is badly invested, but at the prospect of having their names connected with what so far has every evidence of being, for some reason which the owners are ignorant of, a failure.

The one faction charges incompetency, and in rebutter the other charges non-fulfilment of contract, and in the meantime, it is stated that a third party will be asked to make an expert test of the whole thing, and report fully. Then—possibly the lawyers.

The city of Elgin, Illinois, has recently granted a franchise by a council vote of 12 to 0, for the lighting of the residents and residences, and furnishing the inhabitants with telephones. The party furnishing all these luxuries is the Elgin Telephone and Electrical Supply Company, generally known as Will Hubbard's Company. The ordinance restricts prices to $3 per month for exchange telephones within three-fourths of a mile of a central office; $24 each for instruments on exchange lines for corporation use; $8 or less per month for an arc lamp, and a maximum of $1 per month for a glow lamp of ten candle power, or one cent per hour for each ten candle power lamp for private use; and in order to make it still more binding, "always at as low a rate as any other first-class electric light can be furnished."

The Central Electric Company has been compelled by increase of business, to enlarge its premises. Its present one floor and a stairway with limited sidewalk privileges, will develop on the 1st of May into a four floor and basement building, one door south of the present establishment. In other words, the McKinlock boys will hereafter receive their friends on the first floor, and have room for an extra chair or two.

Mr. J. H. Reid, general western manager of the Mather Company's interests, made his appearance at the club the other day, brown and hearty. His western trip has given him a rugged look, and he says fish bite well both in the water and on land, "over there." The 1st of May catches Reid, also. He will move to Room 11, Metropolitan Block, 52 Lasalle street.

Bids were opened last week for boilers and engines for the extension of the city's arc light plant. The same location which is at present used as the central station, will be utilized in the basement of the fire house, corner of Clinton and Washington streets. The addition will include Clark street on the south side, from the river to Van Buren street, and Madison, from the river west to Halstead street. Both these districts need the civilizing influences as badly as ever the good father Pelican wanted wine or the kiss of peace.

But there is much trouble on the part of the tugmen at the possible closing of the bridges nearly all of daylight, and the compulsory running of the river by night. It's "inconvenient and unjust," and all that sort of thing—but it's going that way as sure as ducks fly, and the day is not far off, either.

Since the inauguration of the telephone river service the principal towing companies have had telephones in their offices, presumably for the furthering of the river interest, but it has come to the surface that these have been used for purposes foreign to that for which the city ordered them in, and now the authorities have ordered them out. The city don't like to pay for private telephones.

The Commissioner of Public Works, Swift, says he shall start in on the night-towing

plan as soon as a general movement of vessels begins. A meeting of vesselmen and the Council Committee on Harbor and Bridges was held at the Lumberman's Exchange on the 26th, and while the former protested the latter was firm, and the middlemen helped to maintain peace and bring the whole to a happy conclusion. Resolutions were finally passed expressing confidence in the committee and in the city authorities.

The North Chicago Cable Railway runs through the Lasalle street tunnel, and the tunnel is ordinarily well lighted by Thomson-Houston arc lamps, run from the railway's station, at the corner of Lasalle and Illinois. As there is a double track, and the tunnel is well lighted, and moreover, as the Fifth avenue Bridge is not in service, the tunnel is quite a thoroughfare for vehicles. Both ahead and behind every grip there are nearly always teams of some sort, in the tunnel. Well, one day last week the dynamo stopped, and there was a large amount of scrambling to get out of the way. While this condition of gloom remained, there was fortunately no one injured, but very many were sufficiently frightened to believe that a little farther round is a safer road home, and will heed the proverb in the future. A hot journal was the cause, and the trouble was of short duration.

In accordance with the underground ordinances, the various companies have been in the habit of driving a pipe across streets below the pavements, in places where there is no regular conduit service. On the 27th, some employés of the Chicago Arc Light & Power Company were driving such a pipe across Quincy, at State street, and punctured a gas main. The pipe was being driven from the basement of the Hub clothing establishment.

Word was immediately telephoned to the president's office, and the gas company was summoned. Superintendent Brennan had been called home on account of the illness of his wife, and the danger was not thoroughly realized by the young men who were doing the work. Before the gas men arrived a burning gas jet in the building had ignited the gas, and a huge explosion startled the entire neighborhood. George St. John and Charles Ash were injured by the accident, the latter having his face badly lacerated, but neither was seriously hurt. It is especially requested that papers copying this item will bear in mind that it was gas and not electricity that was the occasion of this trouble.

The damage to the building is thought to be quite serious, and fortunately the employés of the establishment were little injured beyond receiving a wholesome scare; but the coats and waistcoats, shirts, hose and trowsers were badly mixed and scattered, and unlike eggs, will hardly be the better for the lime by which they were covered.

Chicago, April 28. C. C. H.

Utilizing Niagara.

The Niagara River Tunnel, Power and Sewer Company, is now calling attention to its plan of using some of the power of Niagara by means of its tunnel, with which connect conduits in which the water wheels will be placed. The tunnel is to begin a mile above the falls, and end below them. It is claimed that though the depth of water in the river will not be lowered one per cent., over 100,000 horse-power will be developed for mills and for distribution by electricity for light and power. The estimated cost is put at $3,000,000.

An electric surface railway has been patented by Mr. John A. Enos, of Boston, Mass. It is of that class in which storage batteries are used, and the invention relates more particularly to the connections for taking the current from the conductors along the line for charging the storage batteries, and also to the driving mechanism for propelling the car.

The Fall River, Mass., Electric Light Company, will build a new station, the present quarters not having the desired accommodations for the rapidly growing business. Superintendent Leigh is making the plans for the new station.

OUR BOSTON LETTER.

(Special Correspondence.)

The Society of Arts will hold a regular meeting at the Rogers Building of the Institute of Technology on Thursday evening, May 10th. Prof. William A. Anthony, formerly of Cornell, but now with the Mather Electric Company, of Manchester, Ct., will read a paper entitled "A Study of Alternating Generators and Receivers." The meeting is open to persons interested in the subject.

The New England Wiring and Construction Company have been awarded the contract for installing the incandescent system in the reconstructed Hotel Brunswick on Columbus avenue. The building is to be used as a large private hospital by Dr. Flower. 750 lights will be used. The same company will also put in 300 lights in the new Globe building.

The building on the corner of Congress and Franklin streets is becoming an electrical beehive. F. E. Pettingell & Co., who occupy the Franklin street front are enjoying an increased business, and the Loomis Electric Co., who have an office on the Congress street side, are also meeting with good success. They have just installed a 180-light incandescence plant for Richard Hey & Sons, blanket mills at Manayunk, near Philadelphia, Pa.

The Thomson-Houston Carbon Co. has just issued a large lithograph, showing its new manufactory at Fremont, Ohio.

The Edison electric lighting station at Fall River was burned on Wednesday evening last. It is supposed the fire was caused by a short circuit. Six dynamos and three engines were probably totally destroyed. The loss, estimated at $50,000, is nearly covered by insurance.

A small dynamo has been placed in the mining laboratory of the Institute of Technology for experimental work on the electrical deposition of gold from solutions. It was made by the Eddy Electric M'f'g. Company of Hartford, and the preliminary tests show a very satisfactory working.

The next meeting of the Electric Club will be held on Monday, May 7th. There are several candidates for admission to be balloted upon, and arrangements are to be made for a proper celebration of the club's anniversary which occurs now in a few weeks.

The Fort Wayne Jenney Electric Light Company is to open an office shortly at the Hub. A representative of the company has been in the city several days looking for a suitable location, and before many weeks this enterprising company will have added another to the already long list of electric light headquarters in Boston.

Probably more favorable comment is heard upon the Meigs and Mayall systems of elevated railroads, than on any of the other rapid transit petitions now before the legislature. The Riley also comes in for a share of the support of the citizens. The Mayall system embraces three methods of obtaining motive power, cable, electric and pneumatic. The elevated electric road is constructed on much the same principle as the cable road, with some modifications and some additions. The cars are propelled by an electric motor placed on the top of one car in a train of three, and geared to driving wheels, the conductor being well insulated by novel devices for that purpose.

Mr. Edward Blake of the Sprague Motor Company has begun his annual course of lectures on "The Electrical Transmission of Power" before the Technology Seniors in the department of electrical engineering.

The Campbell Electrical Supply Co. has been obliged to move from the Malden manufactory, to more commodious quarters, in Watertown.

The Electric Gas Lighting Company of Boston is making a great success with its single magnet Automatic Gas Burner. This device is winning golden opinions from its users all over the country. Other apparatus of this "go-ahead" company, including its hand lighting gas burner, its gravity drop annunciator, Victor and Hub bells, is appreciated far and near, and the natural consequence is that its manufacturing facilities are taxed to the utmost.

The Eastern Electric Cable Company, manufacturing the Clark wire, has just opened an office at 178 Devonshire street. The works of the company are in Hampshire street.

Boston, April 31. T. W. S.

More About the Flight of Birds.

To the Editor of Electrical Review:

I find in your issue of April 28th a paper on "The Electro-Operations in the Flight of Birds," that I am in a position to comment upon by detailing the results of experiments made with a view of determining the matter.

The birds operated upon were the gannets of South Florida. They were about seven feet in alar dimensions and weighed from eight to ten pounds when full grown, and were splendid adepts at soaring flight.

Among the many hypothesis framed as provisional explanations of the soaring phenomena, some sort of electrical agency was found, the result of air friction on feathers, possibly, and the first step in determining the case was to find whether there was a difference of potential between the soaring bird and the earth.

A difficulty at once presented itself. If the bird was to be experimented on in still air, its velocity of flight, not less than thirty feet per second, prevented its being touched by a conductor; and if a breeze prevailed, although the bird was stationary in such case, still it was out in free air, and very suspicious of the approach of any object.

I discovered a breeding ground of some 500 gannets in an isolated part of the pine woods, and it was during their breeding season that I succeeded in definitely settling the matter so far as those birds were concerned. Their nests were on low bushes in a pond of some three acres in extent, entirely surrounded by the trees. While the sea breeze was coming in, many birds would be resting in the air at varying heights on fixed wings above the pond and surrounding tree tops, and I subjected these to a systematic plan of gross deception. A perch was fixed in the top of a handy tree, which was covered with cloth painted in imitation of the foliage, and from that resting place an excellent view could be had of the soaring creatures at close quarters. I employed a Leyden jar, and also had a wire communicating to the earth, and a galvanometer that a silk handkerchief struck with a glass rod would violently agitate. The birds would at intervals float within two feet of my face, with wings stretched to the utmost, and as motionless as a board. The feathers had not the least appearance of being electrified. There was no standing apart like hairs on a cat's body, but all was very smooth, and tending to the rear with the rushing wind. The birds would *seem* to sleep for fifteen minutes at a time, at least their eyes were shut, and I could readily touch them with a wire in any desired place.

I spent several days in dry, and damp, and hot, and cool weather, making these trials, and never in a single instance could I get the needle to recognize the pressure of the bird by even the most insignificant tremor, and as for charging a jar, it was a conspicuous failure.

So far as the Florida gannets are concerned they can soar without the agency of electricity I am convinced, and hence it is not a tenable hypothesis when applied to other species.

But why not permit gravity to be the actuating agent of a soaring bird? Under certain conditions it will bring a body *down*—a stone for instance. Under other conditions it will send a body *up*, such as a ballon; under still others, such as a soaring bird, why can it not carry a body *horizontally?*

That a competent physicist should stand in shivering impotency in the presence of the great soaring birds is to me incomprehensible.

Respectfully yours,

I. Lancaster.

Chicago, April 27th, 1888.

Says the *Mail and Express:* "At the annual meeting of the Electric Club a few evenings ago, the report presented was most pleasing and satisfactory in every point of view, and shows the club to be in a most flourishing condition."

An electric road between Merrimacport and Merrimac, Mass., is being located by the county commissioners.

Mr. T. McCoubray, agent of the Baxter Motor Co., has recently been making numerous sales and is putting in motors in Pennsylvania and New Jersey and has had that territory added to his former territory in this State.

Norman McCarthy, general agent of the Baxter Motor Company, intends visiting San Francisco and the Pacific coast generally this month, and present the excellencies of the Baxter to the inhabitants of that far-off territory.

The C. & C. Electric Motor Company has just issued another interesting motor catalogue. It contains numerous illustrations, and presents applications of small motors to the mechanical arts, that will be of general interest.

The Julien Electric Company is rapidly putting through the work of preparation for running cars on the Fourth Avenue surface line, this city. Cars are being built and the dynamos for the charging station are being put in. The U. S. dynamo is used.

The Eddy Electric Manufacturing Company has moved from Hartford to Windsor, Conn., where greatly enlarged facilities have been secured. This company is meeting with most gratifying success in the motor field, and has decided to open a New York office.

The following figures show the excellent business done by the Sprague Electric Road in Richmond, Va., as indicated on the books of the company:

	No. of Passengers Carried.
February 2-15	25,450
February 16-29	38,437
March 1-15	49,656
March 16-31	67,887
April 1-15	86,173
	267,603

The City Council of Springfield, Mo., has passed a bill granting to the Detroit Electrical Works, the privilege of maintaining and operating an electric motor railway line on certain streets in this city for a period of twenty years, two miles of the line to be completed and in operation within four months and the entire five miles within one year. The bill is satisfactory to the company and work will begin in a few days. The Fisher motor is the system to be used. When this line is completed Springfield will have about fifteen miles of street railways.

Cloud Telegraphy.

A remarkable experiment in signaling with electric lights was recently made by the officers of two vessels of the British Navy, the Orion and the Espoir, off the port of Singapore.

The Espoir had sailed from that port for Kong Long, leaving the Orion in the harbor of Singapore. When the Espoir was sixty miles distant the Orion sent her a message by means of the electric light.

But can a light be seen sixty miles at sea? Certainly not, in its direct rays; but the Orion threw a brilliant blaze of light upon the clouds, and the reflection of this light was distinctly seen on board the Espoir.

More than this, the Orion, having thrown upon the clouds a regular message by means of successful flashes, this message was read and understood on board the Espoir.

The question has been asked whether this means of communication might not be made of practical advantage. It would depend, it is true, upon the condition of the atmosphere, and upon cloudless nights there would be nothing to reflect from; but it seems entirely practicable to make the light of the most important lighthouses visible much farther at sea on cloudy nights by providing them with an apparatus enabling them to throw a series of reflections upon the clouds.—*Youth's Companion.*

TELEGRAPHIC

.... The telegraph line on the Huntsville branch of the Louisville and Nashville is nearing completion.

.... Memphis, Tenn. has completed her new fire alarm. The system is the Gamewell and works with perfection.

.... At New Albany, Ind., the Council has accepted a proposition from the Louisville, Ky., Fire Alarm Telegraph Company to put its system in operation.

.... Chief O'Malley, of the Geneva, N. Y. Fire Department will have electrical communication established between his residence and the different fire company houses. He is making a move towards the introduction of the fire alarm telegraph system.

.... The laying of the Pacific cable is the one subject being talked of on the Hawaiian Islands Honolulu has advices from New Zealand that the surveying ship will probably soon begin surveying a cable route. She will begin at New Zealand, proceed to Tonga, the Sandwich Islands and thence to Vancouver, British Columbia. A belt 200 miles wide will be examined. The task will occupy from two to three years.

.... The stockholders of the proposed telegraph line from Strong to Eustis, Me. have organized and chosen the following officers: President, William Dolbier of Kingfield; secretary, O. A. Hutchins of Eustis; treasurer, M. B. Pottle of Kingfield; directors, William Dolbier, John Winter, Isaac W. Green, Myles H. Wyman and Orrin Taylor. John Winter was chosen agent to purchase wire, etc., for the line. Poles for the same are being distributed.

.... The railroad telegraphers of New Haven and neighboring towns met last week and organized a division of the order of Railway Telegraphers of North America. The meeting was presided over by S. H. Brown of Boston. H. H. Hayes of 76 Humphrey street is the secretary of the new division. This order was organized at Cedar Rapids, Iowa, in June, 1886, and has a membership of 10,000. An insurance fund has been established and each member may take out a policy for $1,000.

.... On the 8th of May the cables purchased in England were laid between Jicalango and the city of Carmen, Mexico, and between Puerto Real and Isla Aguado, thus placing in instantaneous communication the States of Yucatan and Campeche with the rest of the Republic. Two lines of the same cables were laid in the Grijalva and Coatzacoalcos rivers, by all of which telegraphic communication has been established along the gulf coast. The extent of the land-lines laid from September up to the present reaches a total of 561 kilometers. Thirteen additional offices have been opened, while the 18,000 kilometers which constitute the Federal telegraph system (aside from the lines temporarily ceded to the several States) have been consolidated.

.... In a notice of a Toledo citizen, the Detroit *Free Press* has this to say: "Mr. William Kline, of Toledo, superintendent of telegraph of the Lake Shore & Michigan Southern Railway, is probably the oldest telegrapher continuously in service in this country. He operated the first wires brought to Detroit by O'Reilly, and met the fierce rivalries of the Speed line, built by the father of Judge Speed, with vim and audacity. The Speed line was rather favored by the Michigan Central Railroad, and upon the occasion of the loss of the Mayflower, a steamer once the pride of the lakes, Kline had the satisfaction of beating his rivals out of sight. He transcribed and himself carried to President J. W. Brooks the particulars received by wire, and then bulletined the sad story up town; Brooks could hardly believe the dispatch, not being able to make out how it was that the Speed line had not given him the first information about it. Kline told him that the Speed line in this case, as in all others of importance, was behind, and ought not to be mentioned in connection with the O'Reilly."

The Haynes Double-Pole Incandescent Switch.

Messrs. F. E. Pettingell & Co., of Boston, are the manufacturers and sole agents of the above-named switch, which they state may be termed a Double-Double-Pole Switch, as it breaks each line at two points at the same instant, thus reducing the arc one-half of that of the ordinary double-pole switch. It is positive and instantaneous in its action, can be wired after being placed in position, and is carefully and thoroughly constructed, both mechanically and electrically.

Pole and Wire Mileage.

A despatch from Harrisburgh says: Judge McPherson filed an opinion in a case against the Western Union Telegraph Company to recover taxes on capital stock claimed to be due the Commonwealth for the years 1877 to 1882 inclusive. Accounts had been settled against the company by the Auditor-General for each of these years, charging tax upon that proportion of the capital stock of the company represented by its pole mileage in Pennsylvania. These accounts were all paid except that for 1882, but at the suggestion of J. W. M. Newlin, new settlements were made in which the company was charged upon the basis of combined pole and wire mileage alone, there being a great many additional lines of wire upon some of its poles. Taxes were charged also upon the basis of large stock dividends made in 1879 and 1881 and the company with taxes based, not only upon its own poles and wires, but also upon those owned by other companies but leased to and operated by the Western Union. The claim of the commonwealth was for $72,592.84. In the argument of the case Mr. Newlin represented the commonwealth as special counsel and M. E. Olmsted, Esq., defended the company. The court holds that the combined pole and wire mileage is the proper basis, but declines to tax the company upon poles and wires owned by other corporations, it having been shown in evidence that the other corporations paid tax upon their own capital stock representing their own property. The court also finds that nothing is due to the State on account of stock dividends for 1879 and 1881, judgment for all taxes in relation to them having been obtained in previous suits and paid by the company. The amount found due to the State in this case is $13,809.70.

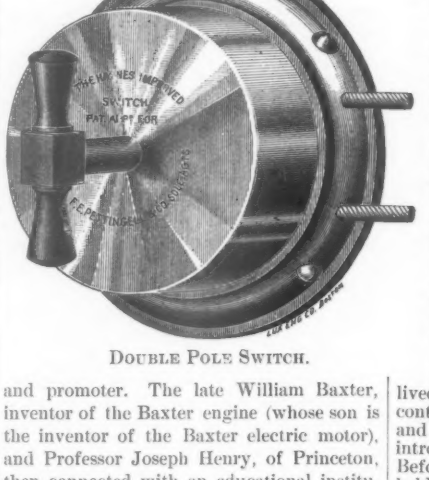
What the Blizzard did for the Southern New England Telephone Company.

The quarterly dividend of the Southern New England Telephone Company, this time one per cent. instead of one and a half, a reduction due to expense entailed by the blizzard and the erection of the Hartford cable, is now being paid. In submitting the directors' quarterly statement, President Morris F. Tyler says: "It will be seen that the increase of expense has been chiefly in the item of repairs and maintenance, though some of the increase in the last item, though not brought under the heading of repairs and maintenance, was occasioned by the same causes; that is, the extreme severity of the season. The operating expenses, which are in the nature of fixed expenses, have remained substantially the same. The increase in instrument royalties and commissions is occasioned by an increase in the amount of extra-territorial business done, and in the increase of the number of stations. The directors feel safe in saying that the small amount of net profit for the quarter is due purely to the exceptional conditions of the last three months, which we have no reason to believe will be repeated in any of the subsequent quarters of the year. Without the extraordinary expenses occasioned by the purely exceptional circumstances of the blizzard, and of some changes in the location of our plant, which were forced upon us by property owners, especially in Hartford, the net earnings of the last quarter would have been large as usual." The total earnings are $71,413.58, as against $70,443.40 for the corresponding quarter last year. The expenses aggregated $55, 824.38, as against $49,977.10, and were divided as follows: Royalties and commissions, $19,-208.35; operating, $14,523.21; repairs and maintenance, $12,215.18; all other expenses, including rents, executive office, postage and printing, etc., $9,877.64. The balance for dividends is $15,589.20.

Some Telegraph History.

ALFRED VAIL'S CONNECTION WITH THIS GREAT INVENTION.

Century Magazine for April, contains an interesting account of the invention of the electric telegraph, by Franklin Leonard Pope, in which the share that Mr. Alfred Vail, of New Jersey, had in that wonderful work is carefully and clearly brought out. We summarize as follows: Judge Stephen Vail, of Morristown, then proprietor of the Speedwell Iron Works, furnished the capital needed for the development of the invention of Morse, and in that development, Alfred Vail, the Judge's son, was an important aid and promoter. The late William Baxter, inventor of the Baxter engine (whose son is the inventor of the Baxter electric motor), and Professor Joseph Henry, of Princeton, then connected with an educational institution in Albany, New York, were also identified with the inception of the invention in its early history. Baxter, then a youth of only fifteen, was the confidant and assistant of Alfred Vail.



DOUBLE POLE SWITCH.

After young Vail had completed his studies in the village school of Morristown, N. J., he entered his father's works, where, with his brother George, he remained until he had attained his majority, in compliance with his father's wish that his two sons should fit themselves to succeed to the management of the works, then and afterwards famous for divers notable additions to the world's mechanical appliances. For it was at the Speedwell Iron Works that was forged the shaft of the first steamship, the Savannah, that crossed the Atlantic; and here were made the cranks, tires and axles of the first American locomotive. At the age of twenty-one, Alfred Vail began the preparation needed for his entrance to the Presbyterian ministry, and in 1832, when he was twenty-five years old, he entered the University of the City of New York, from which institution he graduated in due course, in October, 1836. During the latter part of his student's life in the University, young Vail was under the instruction of Professor Gale, who then occupied the chair of chemistry, and who was afterwards active and highly useful in the great work with which the Vails and Prof. S. F. B. Morse were engaged.

Morse, while on a voyage from Havre to New York, on the packet-ship Sully, in 1832, had conceived and had drawn in his sketchbook the first rude elements of what subsequently became famed as the first apparatus for recording signals at a distance by means of electro-magnetism. During the next five years Morse was engaged in developing his crude invention. In 1837, much attention having been awakened throughout the civilized world by experiments in this direction, the House of Representatives passed a resolution directing the Secretary of the Treasury "to report upon the propriety of establishing a system of telegraphs for the United States." At that time Morse, without the means needed to employ skilled workmen, had been unable to put his invention into practical or permanent form. Stimulated by the hopes awakened by the resolution of the House of Representatives, Morse endeavored to bring his work to the intelligent observation of others who might assist him. In September, 1837, having put up several miles of wire in one of the rooms of the New York University, he made a demonstration of the apparent practicability of his new system of telegraphic signals. Among those who witnessed that exhibition was Alfred Vail. He was profoundly impressed by what he saw, although the results were only an exchange of what might be called unintelligible signals over the wire.

Alfred Vail had inherited and acquired mechanical skill; his education and training at the University had given him some insight into the affairs of the world, and his mind intuitively formed a distinct conception of the grandeur and importance of the vast work here dimly foreshadowed. Among the papers left by Mr. Vail is one giving an account of this incident. Referring to his occasional visits to New York during the year following his graduation, he says:

> On one of these visits, prior to September 4, 1837, I accidentally and without invitation called upon Professor Morse at the University and found him, with Professor Torrey and Dubeny, in the mineralogical cabinet and lecture room of Professor Gale, where Professor Morse was exhibiting to these gentlemen an apparatus which he called his "Electro-Magnetic Telegraph." * * * * I saw this instrument work and became thoroughly acquainted with the principles of its operation, and, I may say, struck with the rude machine, containing as I believed, the germ of what was destined to produce great changes in the condition and relations of mankind. I well recollect the impression which was then made upon my mind. I rejoiced to think that I lived in such a day, and my mind contemplated the future in which so grand and mighty an agent was about to be introduced for the benefit of the world. Before leaving the room in which I beheld for the first time this magnificent invention, I asked Professor Morse if he intended to make an experiment on a more extended line of conductors. He replied that he did, but that he desired pecuniary assistance to carry out his plans. I promised him assistance provided he would admit me in a share of the invention, to which proposition he assented. I then returned to my boarding-house, locked the door of my room, threw myself upon the bed, and gave myself up to reflection upon the mighty results which were certain to follow the introduction of this new agent in meeting and serving the wants of the world. With the atlas in my hand, I traced the most important lines which would most certainly to be erected in the United States, and calculated their length. The question then rose in my mind whether the electro-magnet could be made to work through the necessary lengths of line; and after much reflection I came to the conclusion that provided if a magnet would work even at a distance of eight or ten miles there could be no risk in embarking in the enterprise. And upon this I decided in my own mind to sink or swim with it.

A visit to Morse, soon after, so fully satisfied Vail of the feasibility of the invention that he agreed to persuade his father to put some money into the enterprise, and, after Morse had been taken to Speedwell to lay his plans more fully before Judge Vail, that gentleman consented to embark in the work. The Judge, it may be added, was warmly interested in the half-hidden invention, and as an evidence of his faith, he agreed to assist, his son being admitted to a partnership in his enterprise. Alfred Vail was to be the agent through which the capital was to be invested and he was to construct at his own expense and exhibit to Congress a telegraphic apparatus "of the plan and invention of Morse." Alfred's time and money were to be used in the exhibition of the invention and in procuring the necessary papers, in consideration of which he was to receive one-fourth of all rights of the invention in the United States.

Taking a room in the Speedwell Iron Works, secluded and kept carefully locked, Alfred Vail, assisted by Baxter, devoted himself to a perfection of the apparatus. In later years, Baxter writing of this critical episode in the history of the invention, said: "I was at that time an employe of the works and was in my fifteenth year. It was a high compliment for a boy of that age to be selected for such a trust, but it is not for me to criticise the judgment of those who were responsible for the appointment. For many months Alfred Vail and myself occupied that room, sharing each other's confidences, and experiencing alternating emotions of elation and depression, as the vicissitudes of the experiment gave promise at one time of a glorious success and at another of a humiliating failure.

"When the shop was rebuilt, several years

ago, this room was preserved intact, and the descendants of Judge Vail still cherish it as a memorial of the infancy of one of the grand achievements which mark the progress of modern civilization. * * * The hard-fisted New Jersey farmers looked upon the experiment as a wanton and inexcusable waste of money, and were accustomed to speak of it as the one solitary instance of bad judgment on the part of the Vails."

Prof. Henry, in 1832, had actually constructed an electro-magnetic signallinga paratus which was as truly an electric telegraph as that of to-day. This invention which is the germ of the present telegraph system, was described by its inventor in the following terms: "I arranged around one of the upper rooms in the Albany Academy a wire of more than a mile in length, through which I was enabled to make signals by sounding a bell. The mechanical arrangement for effecting this object was simply a steel bar permanently magnetized, of about ten inches in length, supported on a pivot, and placed with its north end between the two arms of a horse-shoe magnet. When the latter was excited by the current, the end of the bar thus placed was attracted by one arm of the horse-shoe and repelled by the other, and was thus caused to move in a horizontal plane and its farther extremity to strike a bell suitably adjusted."

When Morse began to experiment in the transmission of the electric current, he found that the current was ineffective (with his feeble magnet) except at comparatively short distances. His code of signals was numerical, not alphabetical, and required the preparation of a voluminous dictionary in which every word was represented by an arbitrary character. The experiments of Prof. Henry pointed out the remedy for enfeebled electric currents, and a battery of many series of pairs of plates was found equal to the requirement of sending a current effectively through a long conductor. How Alfred Vail invented the dot and dash system of telegraphic writing is thus related by Baxter; "Alfred's brain was at this time working at high pressure, and evolving new ideas every day. He saw in these new characters the elements of an alphabetical code by which language could be telegraphically transmitted in actual words and sentences, and he instantly set himself at work to construct such a code. His general plan was to employ the simplest and shortest combinations to represent the most frequently recurring letters of the English alphabet, and the remainder for the more infrequent ones. For instance, he found upon investigation that the letter *e* occurs much more frequently than any other letter, and accordingly he assigned to it the shortest symbol, a single dot (·). On the other hand, *j*, which occurs infrequently, is expressed by dash-dot-dash-dot (— · — ·). After going through a computation, in order to ascertain the relative frequency of the occurrence of different letters in the English alphabet, Alfred was seized with sudden inspiration, and visited the office of the Morristown local newspaper, where he found the whole problem worked out for him in the type-cases of the compositors. In this statement, I have given the true origin of the misnamed 'Morse' alphabet, the very foundation and corner-stone of a new system, which has since become the universal telegraphic language of the world."

The new apparatus was finally set up in one of the Speedwell rooms, and, on the 10th and 11th of January, 1838, the people of Morristown were publicly invited to see intelligible telegraphic signals transmitted through three miles of wire. The demonstration was highly satisfactory. Previous to this, however, Judge Vail, whose patience had been sorely tried by the mischances and delays of the inventors, and who had begun to despair of ultimate success, was given "a private view" of the apparatus. The money put into the work by the Judge represents what in those days was a large sum; without it, or a similar amount of financial aid, the electric telegraph could not have been invented by Morse. While Morse and Vail were at work on the apparatus at the Speedwell concern, they dared not meet Judge Vail for fear of precipitating a financial crisis. They had passed the point when, in their first sanguine expectations, they set a limit to their possible expenditures. The two assiduous workers, afraid to face their purveyor of financial supplies, stole out of their workshop furtively when they learned that the coast was clear and their meals were made ready for them in the friendly house of Dr. Cutter, Alfred Vail's brother-in-law. Alfred Vail accompanied Morse to Philadelphia and Washington when the new invention was exhibited; and when, after many disappointments, the Congressional appropriation of $30,000 was available for the construction of the experimental line between Baltimore and Washington (early in 1844), he was Superintendent of the Machinery Department, of the enterprise. In this position his services were numerous and invaluable.

The *Century* article concludes as follows: It is self-evident, therefore, that not a single feature of the original invention of Morse, as formulated in his caveat and repeated in his original patent, is to be found among the essential constituents of the modern apparatus. Prior to 1837, it embodied the work of Morse and of Henry alone. From 1837 to 1844, it was a combination of the inventions of Morse, Henry and Vail; but, as we have seen, the elements contributed by Morse have gradually fallen into desuetude, so that the essential telegraph of to-day, and the universal telegraph of the future, comprises solely the work of Joseph Henry and Alfred Vail. The grandeur of Vail's conception of an alphabetical code, based on the elements of time and space, has never met with the appreciation which it deserves. Its utility is not confined to electric telegraphy. It is used to signal, by intermittent flashes of light, between far distant signal stations of the Coast Survey, and between the different vessels of a fleet; it is sounded upon whistles and bells to convey intelligence to and from steamers cautiously feeling their way through the obscurity of fogs; and in fact nearly every day brings to notice some new field of usefulness for this universal symbolic language. It appeals to almost every one of our senses, for it may be interpreted with almost equal facility by the sight, the touch, the taste, and the hearing. Indeed, with a charged electrical conductor and a knowledge of Vail's alphabetical code, even the transmitting and receiving instruments of the electric telegraph may be dispensed with in emergencies.

Electricity Finds a Place in Fiction.

A story comes from Richmond, Ky., to the effect that Patrick Cunningham has discovered a means of ridding a troubled world of snakes and venomous reptiles of every kind. He claims to have a lotion, which, when swallowed, makes a person serpent proof. When a snake's fangs strike this liquid in the human body, an electric current is generated, which drives the poison in the reptile's body through every blood vessel in its system, causing almost instant death. This story dressed up with many attractive details, is published in a popular newspaper as a solemn fact. Cunningham, in the paper, is called a "prototype" of St. Patrick.

Compound Telephone and Telegraph Wires.

An old idea, first tried in America some years ago, has been revived by Messrs. Kareis & Bondy, Vienna, who have patented iron or steel wires covered with a spiral serving of copper wire or ribbon of very small thickness. These wires are now being tested at the laboratory of the Electrotechnical Institute in Vienna, and have so far given fairly good results. The object of the invention is to provide aerial wires having less self-induction and resistance than ordinary iron or steel wires, without sensibly diminishing the mechanical strength. The wire is intended for use with currents of rapid period, such as occur in telephony or in high speed telegraphy, and as through self-induction the flow of current is displaced from the centre to the circumference, the inventors argue that it would be useless to make the centre of a material having a high conductivity.

The Ide Engine.

The demand during the past six months for the Ide and Ideal automatic cut-off engines has been greater than ever before in the company's history, and much in excess of the capacity of the works. They are now crowded with orders and working nights. They are now building an addition to the shops, which will be 50 feet by 180 feet, 20 ft. ceilings and equipped with traveling power crane and the most modern tools for such work.

Recent shipments are: Chicago & Northern Ry., for Clinton, Iowa, one 40 horse power Ide engine, their Chicago depot one 60 horse power Ide engine, and for Escanaba, Mich., one 60 horse power Ideal engine, all for driving electric lights. Also Fond Du Lac, Wis., Gas Co. one 80 horse power Ideal. Hibbard, Spencer, Bartlett & Co., Chicago, one 60 horse power Ide. Chicago City Ry. Co., for 20th street station, one 60 horse power Ideal. Consolidated Coal Co. of St. Louis, one 100 horse power Ide engine.

They are building, besides, we are informed, one 60 horse power Ide for Mr. McCormick, of Chicago, one 80 horse power Ideal for Excelsior Electric Co. for Union Stock Yards, one 45 horse power Ideal for Western Edison Electric Co., Denver, one 200 horse power Ide for Union Cement & Lime Co., Louisville, Ky. Also building 100 horse power Ide engines for the Chicago Auditorium Building, to be operation in time for lighting the building for the Republican National Convention.

The Separation of the E. M. F. of Cells into their Potential Differences.

The E. M. F. of a cell consisting of zinc, dilute zinc chloride, concentrated zinc chloride, zinc was found by direct measurement to be 0.15 volt. By means of electrodes consisting of drops of mercury the absolute value of the potential difference at the common surface of the metal and dilute solution was found to be 1.10 volt, and between the metal and concentrated solution 0.68 volt. The potential differences between the two liquids was 0.27 volt. Hence the total calculated E. M. F. is 1.10−0.27−0.68=0.15 volts, which agrees with the value found by direct measurement.

In a Daniell cell the potential difference between zinc and zinc sulphate=198; between zinc, zinc sulphate, copper sulphate=232; between copper and copper sulphate=40; therefore the total E. M. F. is 232−40=192, the value obtained by direct measurement.

A Latimer Clark cell gave the potential difference of zinc and zinc sulphate=183; of mercury, mercurous sulphate, zinc sulphate=62; therefore the total 183+62=245, or 1.43 volt, which agrees very closely with the exact value.—*Beiblätter.*

The Electric Motor and Storage Battery in Baltimore.

The Monumental City is taking quite an interest in electric street car work just now. A trial recently had in that city is described at length in all the papers, from one of which we publish an extract below. Mr. A. G. Davis, the well known president of the Viaduct Manufacturing Company, has been interested in this work for a number of years, and is justly proud of this success. The following is from the Baltimore *Sun:*

The street railway passenger car of the Electric Storage Company of Baltimore made its first trip down town yesterday and excited much interest and a great deal of favorable comment. It started from the stables of the North Baltimore Passenger Railway Company with fifteen persons, but the number was soon increased to forty. Among those aboard were Dr. Frank Donaldson, Robert Rennert, T. Edw. Hambleton, A. G. Davis, Jas. R. Clarke, General Foote, of California, A. C. N. Matthews, Charles Frick, James L. McLane, Abner Sanks and Wm. H. Donaldson. The run was made in the most satisfactory manner down Linden avenue to Howard, to Lexington, to Charles, to German and around the City Hall. The car was followed by a crowd of urchins. The complete control under which the car is run was illustrated on Linden avenue when a carriage got in the way. The brake was put down, the current reversed and the car stopped almost instantly. While traversing the business section of the city merchants and clerks threw open the store windows and doors and stood watching the car until it was out of sight. Some looked rather astonished, while others smiled as if congratulating themselves on the prospect of being carried around by electricity in the future. Going up and down the steep grade on Charles street the motor stopped and rested as easily as if on level ground. It stopped at the movement of the manager's hand in a less space than a car drawn by horses and started again as quickly, without any straining or jarring, and ascended the hill much faster than a horse car usually does. The car made good speed on the grooved rails on Charles street, which is a difficult piece of track to run upon, and showed a fast speed on Boundary avenue bridge. It swung around the double curve at the corner of North avenue and Charles street in a satisfactory manner. The party on the car voted it a great success. The car weighs six tons, including the battery. The battery will carry the car forty miles without refilling, and is of ten-horse power.

A New Insulating Compound.—A very valuable insulating material, described in the *Chronique Industrielle*, has just been produced. It is composed of one part Greek pitch and two parts burnt plaster, by weight, the latter being pure gypsum, raised to a high temperature and plunged in water. This mixture when hot is homogeneous, viscous paste, and can be applied by a brush or cast in molds; it is amber-colored, and possesses the insulating properties of ebonite, and can be turned and polished. Its advantage is its endurance of great heat and moisture without injuring its insulating properties.

Telephonic News

*** The telephone system of Brattleboro, Vt., which had been in a demoralized condition, is undergoing repair, new wire and cables taking place of the old.

*** Superintendent Daboll is making a number of improvements in the telephone exchange at Springfield, Mass. The multiple switch board is being put in, and the number system of calling consequently adopted.

*** Electrician Seeley, of the Metropolitan Telephone Company, is one of the most ingenious workers and inventors in the telephone field, and is now at work on a new and promising telephone switching system.

*** The Gilliland Electric Company, of Adrian, Mich., has shipped over 60,000 telegraph pins to the American Telephone Company, of New York, for use in constructing the line from Albany to Buffalo.

*** Commander C. F. Goodrich, U. S. N., in charge of the torpedo station at Newport, R. I., was a visitor at the REVIEW office last week. His work at the station is important and interesting, and electricity forms a valuable factor in his experiments. The new exchange of the Metropolitan Telephone Co. was visited by Commander Goodrich while in the city.

*** Mr. Eugene F. Phillips came over from Providence last week and had difficulty in convincing his New York friends who he really was, the sacrifice of his majestic moustache (to make it more convenient for the succulent Rhode Island clam) changing his appearance so greatly. At the Electric Club he was introduced by Col. Goodyear as "Mr. Young, a ranchman from Kansas," and a number of his old-time friends were taken in.

*** The following is a statement of business of the New England Telephone and Telegraph Company for quarter ending March 31st, 1888:

Gross receipts for three months ending March 31st, 1888	$266,327 72
Expenses for three months ending March 31st, 1888	190,334 24
Net earnings for three months ending March 31st, 1888	75,993 48
Construction for three months ending March 31st, 1888	3,269 54

The Telephone in Wheatstone Bridge Measurements.

TO THE EDITOR OF ELECTRICAL REVIEW:

In your issue of April 14th, 1888, a Wheatstone Bridge method of measuring resistances is recommended, in which an interrupted current is used and a telephone substituted for the galvanometer.

While this method is of use in some cases, its limitations should be clearly understood, otherwise errors will occur.

Prof. Kohlrausch, of Germany, used this method with an alternate current and a telephone, to get rid of polarization of the electrodes in measuring the resistances of liquids.

A model of his bridge and rheostat, with induction coil and telephone attached, was exhibited at the Franklin Institute Exhibition in 1884.

The method is only of value when there is no self-induction in the resistance to be measured, consequently for armature-coils, magnets, coils of wire, etc., the self-induction sets up currents at breaking or reversing the current that render the telephone useless.

This can be easily proved by using a galvanometer with a constant current, when the two results will not agree.

On telegraph lines, electric light circuits, etc., approximate results will be obtained, if all relays, magnet coils, etc., are excluded; but even then as was shown by some French investigations of this method, the induction in the coils of the resistance box itself, vitiate the results.

Yours truly,
CHAS. H. RICHARDSON,
Late Electrician for Queen & Co., Phila.
PHILADELPHIA, April 23, 1888.

Experiments on the Blake Contact.

GEORGE W. PATTERSON, JR., A. B., S. B., BEFORE THE AMERICAN ACADEMY OF ARTS AND SCIENCES, JAN. 11, 1888.

In the spring of 1887, Mr. H. J. Tucker and I experimented on the contact in the Blake microphone transmitter, with the object of determining, if possible, the relation between the normal pressure at the contact, and the current in the receiver of the telephone, which was placed in the secondary circuit of an induction coil in the usual manner.

The object of our work being to determine the variations in the secondary undulatory current caused by variations in the normal pressure at the microphone contact, we required some simple way of regulating the contact pressure, some way, if possible, which would admit of reproducing the same results from the same conditions of pressure and sound. This latter we failed to accomplish satisfactorily.

Having removed the door, including the microphone contact and the mouthpiece, from the transmitter, we fastened it to the table, leaving space between it and the table for an organ pipe (512 complete vibrations per second), which we used as our source of sound.

To obtain a sound of constant intensity we blew the pipe by means of an air blast driven by the engine in the Rogers Building. The air was regulated by two pressure regulators, one allowing part of the air to escape, the other balancing the air pressure by a column of mercury. The height of the mercury could be changed at will.

The pressure in the Blake contact is regulated by the attachment of the carbon electrode to a spring, whose tension is adjusted by a screw. In addition to the spring, which we used for preliminary adjustment, we applied pressure by means of a lever arm carrying a scale-pan at its center, one end of which rested on the electrode, the other carrying a knife-edge resting on glass, acted as a fulcrum. The scale-pan was covered by a piece of velvet, in order that the addition of weights might cause no jar at the contact. In our experiments we found that any attempt to take off weights had the effect of disturbing the adjustment of the contact to such an extent as to change the series. This same result was frequently brought about by the jarring of the ground from the street traffic.

We used a more powerful induction coil than that in the Blake transmitter. The resistance of its primary was 0.5 ohms, and of its secondary, 899.0 ohms.

We experimented on various forms of battery with varying arrangements of the cells, to observe the effect of changes in electro-motive force and in resistance. The currents to be measured were very small, and consequently some extremely sensitive form of electro-dynamometer was required. We used one of the Kohlrausch pattern with movable coils, which we wound of No. 40 (B. & S. gauge) double silk-covered wire. The two outer coils might be used either in parallel or in series with each other, and in either way with the inner (suspended) coil.

This dynamometer, which differed in some of its details from the instrument as ordinarily made by Hartmann, was constructed especially for experiments of this nature by Mr. Otto Scholl, the mechanician of the laboratory.

The condition of maximum sensitiveness with coils of a given size, is obtained by arranging them so that the product of the ampere-turns in the outer and the inner coils is a maximum.

In designing our inner coil, we were limited by the size of the tube in which it turned. This coil we wound with as many turns as possible, giving a resistance of 180 ohms, which was not too large for the best conditions, the resistance of the induction coil being high. We then wound two outer coils, each of 800 ohms resistance, which were as large as it was convenient to fit on to the dynamometer.

For maximum sensitiveness, the resistance of the outer coils should be equal to one-fourth of the resistance in circuit. The sensitiveness falls off much more rapidly with decrease of resistance below this point, than it does by increase of resistance above this point. The law being represented by the equation, $Y=\frac{X}{(a+\beta X^2)^2}$ in which Y is a measure of the sensitiveness, X the resistance per foot of the wire in terms of the resistance per foot of the wire of the standard coil, β the total resistance of the standard coil, and a all other resistance in circuit, about 1,100 ohms. βX^2 is the resistance of the outer coil, the resistance of a fixed weight of wire being inversely as the square of its resistance per foot. Y is a maximum when $a=\frac{1}{3}\beta X^2$.

It will be seen from the above equation that if the outer coils are used in series, the resistance, 1,600 ohms, is much too large; if they are used in parallel, the resistance, 400 ohms, is also large; and the instrument is 64 per cent. more sensitive with the parallel arrangement. For best effect, the wire of the outer coils should have had a section 91 per cent. larger, and the coils should have been used in series, or a section 4 per cent. larger, and have been used in parallel. However, we found that if the outer coils were used in parallel, the dynamometer was sufficiently sensitive.

For a suspension, we finally used a platinum wire, 0.004″ in diameter, all lighter ones breaking, because of the weight of the coil. The length of the wire was about twenty inches The inner coil carried a vane, swinging in dilute sulphuric acid, by which one connection was made, the other being made by means of the suspending wire. Mercury was not used, as its surface tension would not allow free enough motion of the contact wire. The deflection of the inner coil was read by a telescope and scale, a mirror being fixed to the coil. * * * * * *

These difficulties were overcome by setting up the dynamometer with the planes of its outer coils east and west, connecting it in series with a very sensitive bell-magnet galvanometer, and observing the corresponding deflections. Series were taken by varying the resistance in circuit, and also reversing the current both at the battery and in the inner coil. The bell-magnet galvanometer having been calibrated by a standard instrument, we computed the currents (a variation of 0.00001 ampere in the current could be measured) corresponding to the different deflections, and plotted the curves of deflection and current for the dynamometer. These curves were found to be two equal parabolas, whose equations were $C^2-1.297\,C=-.134\,S$, (1) and $C^2-1.297\,C=.134,\,S$ (2), C being the current in milliamperes and S the scale readings in millimeters.

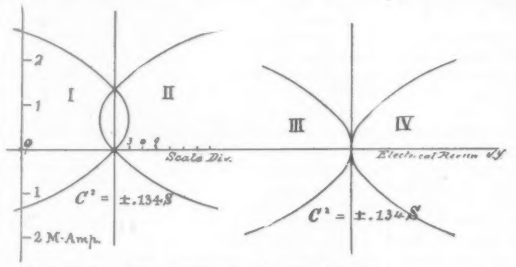
Each parabola was constructed from two series of measurements, in both of which the relative directions of the current in the outer and inner coils were unchanged, each series being represented by a branch of the parabola.

It was next necessary to find the law which the dynamometer would follow for alternating currents.

Taking the forces acting along any line passing through the center of the coil, we have for the action between the coils a force proportional to the square of the current, and for the action of the earth's magnetism on the suspended coil a force proportional to the current. These two forces are balanced by torsion. Expressed in the form of an equation, this gives $aC^2+\beta C=\gamma$, where C is current and a, β, γ constants for that position. To obtain the same deflection we might have used a negative current, C^1, which may be expressed as $-n\,C$, then $a\,n^2\,C^2-\beta\,n\,C=\gamma$; from these two equations it follows that $a\,C^2n=\gamma$, that is, eliminating the earth's action, a steady current of $C\sqrt{n}$ would produce equilibrium in this position. But, as $C\sqrt{n}$ is a mean proportional between the arithmetical values of the two currents which produce equilibrium in this position, we have simply to find the mean proportional for each position, and construct a new curve. Solving equations (1) and (2) we get

$$C=\frac{1.297}{2}\pm\sqrt{\left(\frac{1.297}{2}\right)^2\pm.134\,S}.$$

A mean proportional between the values of C for (1) is $-.134\,S$; for (2) it is $+.134\,S$. Therefore, the equations for a direct current when the inner coil is free from the earth's effect, are $C^2=-.134\,S$ (3) and $C^2=+.134\,S$ (4). In the case of an alternating current we have a continuous variation in strength; but if we understand by C^2 the mean value of the square of the current, and not the square of its (arithmetically) mean value, which is nearly 20 per cent. smaller, when the current variations are are of a simple harmonic character, we may use equations (3) and (4) to express variations of current and deflection for alternating currents. In changing from (1) and (2) to (3) and (4) we have made a change in the axes only, the curves being identical.

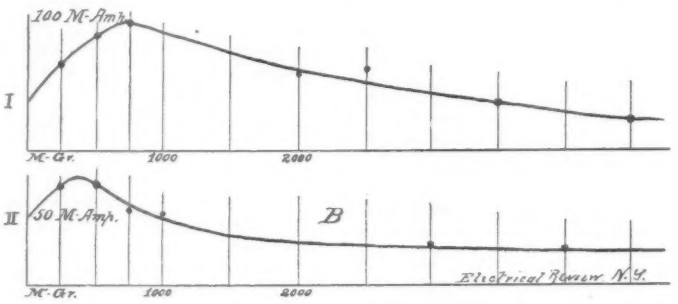


It will be seen from the demonstration that this transformation of axes without change in the form of curve is peculiar to the parabola.

The calibration being completed, we proceeded to investigate the law of pressure and current, using the Dolbear and chromic acid primary batteries and the Brush storage battery.

The pressure at the contact was adjusted by the spring until the addition of 25 m.gr. would allow sound to be transmitted through the telephone; the weight was then increased, at first by additions of 250 or 500 m.gr., and afterward more rapidly. (In some series the increment was only 25 m.gr.) The deflections, the quality, and the intensity of the sound transmitted, were noted. The following plots and tables will serve as examples of the series.

The values given are those of the steady currents which, in the absence of any magnetic effects from the earth, would give the deflections observed. As the precise form of the variation of the current is uncertain, no better mode of procedure has suggested itself. The columns headed Def., C., Wt., etc., contain the observed deflections, the calculated currents, and the weights in the pan. These weights should be divided by 2 to obtain the pressure at the contact.



BRUSH STORAGE BATTERY, TWO CELLS IN PARALLEL.

(1)

Def.	C.	Wt.	Remarks
.85	.34	0	Broken sound.
3.05	.64	250	
5.30	.84	500	Loud, and beginning to be musical.
6.45	.93	750	Loud and good.
4.35	.76	1,000	Lower, and clear.
3.95	.73	1,500	Wavy.
2.55	.59	2,000	Good.
1.75	.68	2,500	
1.10	.39	3,500	Low.
.32	.20	4,500	Very low.

(2)

Def.	C.	Wt.	Remarks.
2.20	.54	0	Roaring.
4.05	.74	250	Bad.
4.30	.76	500	
2.10	.53	750	Loud, and beginning to be good.
2.05	.52	1,000	
.65	.29	3,000	Loud and good.
.65	.29	4,000	Good, but growing fainter.
.45	.25	5,000	

It will be noticed that the current rises very rapidly at first with this increase of pressure. At all points of this rapid rise the sound transmitted is very bad, and there are very frequent breaks with the intensity of sound employed. The maximum is soon reached, at about 1,000 m.gr. pressure, and from that point the current falls off gradually. The sound becomes good soon after the maximum current is reached, and as the pressure increases, the sound diminishes in intensity, but improves in quality. In all our experiments the same form of curve represented the variation of pressure and current, and in all, the best sound was transmitted directly after the maximum current.

I find that this form of curve is in harmony with theory, assuming that the pressure at a microphone contact varies inversely as its resistance. The total resistance in the circuit is a constant plus the resistance of the joint. This may be expressed by the equation $R=a+\frac{\beta}{P}$, R meaning resistance, P pressure, and a and β constants. But, $C=\frac{\gamma}{R}$, C meaning current and γ a constant; therefore $C=\frac{\gamma\,P}{a\,P+\beta}$. Suppose the sound waves due to the pipe to cause a varying pressure on the contact, whose extreme values are $\pm\,\delta$. The extreme values of the resulting current will be in each vibration $\frac{\gamma\,(P+\delta)}{a\,(P+\delta)+\beta}$ and $\frac{\gamma\,(P-\delta)}{a\,(P-\delta)+\beta}$. The difference between them will be proportional to the secondary current I. The secondary current depends on the rate of change in the primary. This relation may be expressed by the equation

$$I=\Theta\left[\frac{P+\delta}{a\,(P+\delta)+\beta}-\frac{P-\delta}{a\,(P-\delta)+\beta}\right]=\frac{2\,\beta\,\delta\,\Theta}{a^2\,(P^2-\delta^2)+2\,a\,\beta\,P+\beta^2},\qquad(1)$$

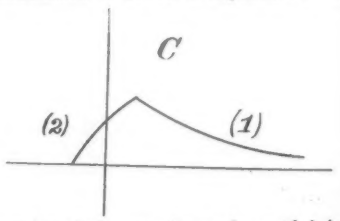
If P is less than δ, it is evident that the electrodes will break contact, a minus pressure being impossible. In this case the current at one extreme will be $\circ$ instead of $\frac{\gamma\,(P-\delta)}{a\,(P-\delta)+\beta}$, and the secondary current I will be $\frac{\Theta\,(P+\delta)}{a\,(P+\delta)+\beta}$, (2)

When $P=\delta$, these two values for I are identical. The curve, obtained by following (2) up to the point $P=\delta$, and (1) after that, is similar to the accompany sketch (C).

The similarity between the curves B and the curve C shows the close agreement of theory with the results observed.

The first part of the curve, corresponding to equation (2) of incomplete contact, is the curve of imperfect transmission; the last part of the curve, corresponding to equation (1) of complete contact, is the curve of good transmission.

From equations (1) and (2) it will be noticed that the pressure required for good transmission of sound is dependent on the



intensity of the sound, good sound being transmitted if δ is less than P. The sound in the receiver is loudest when δ is nearly equal to P.

In experimenting with electro-motive force greater than 3 volts, we met with unsatisfactory results. Good sound was not transmitted except under heavy pressure, and all attempts to obtain satisfactory measurements failed on account of the well-known disturbances set up in the microphone by the current itself.

In certain of our experiments the resistance of the primary circuit was diminished by joining a number of cells in parallel. The uniform result was that the sound transmitted was louder.

The results of our experiments may be summed up as follows:

The resistance of the primary circuit and especially that of the battery should be as low as possible; the pressure at the contact should be no greater than is required to transmit good sound, that is, it should be a little greater than that required to give the maximum current; with the present form of Blake contact, no electro-motive force greater than 2 volts should be used; and, finally, the contact should be carefully guarded against jarring.

Our work should be considered not as a complete investigation, but as part of the foundation for future work in the Rogers' Laboratory; for our results have been more in the invention of methods than in the use of them. We trust that the work in which we have had a share may be successfully carried out in the future.

A New System of Series Incandescent Lighting.

The Bernstein Electric Light Manufacturing Company, of Boston, is now introducing a new device for using incandescent lamps in series on independent circuits or on arc-light circuits in direct series with the arc-lamps.

Such a method of using incandescent lamps has many advantages when the distribution is to be over a large territory, as in the case of street lighting for towns, and it is also claimed by many that it is equally desirable for isolated plants, especially when the lamps are to be much scattered, owing to the extreme simplicity of the wiring and the small amount of wire required.

In such a system it is, of course, absolutely essential that there should be no possibility of the circuit being opened through the failure of a lamp, and also that there should be entire immunity from any danger of personal contact with the high tension currents used. Both of these features seem to have been very carefully considered and effectually provided for in the appliance shown by the accompanying illustrations.

The automatic cut-out for providing for the current a path around a broken lamp is not dependent upon an electro-magnet for its action and is entirely free from complicated mechanism. It originated with Mr. Alexander Bernstein, now of London, and it is claimed that a series of tests, extending over many months, has shown it to be absolutely reliable. The cut-out itself is termed the "contact," it is shown in Fig. 1, and may be briefly described as follows: It is composed of two metal pieces supported by strips of insulating material, and separated from each other by a compound of very high electrical resistance; it is inserted in the lamp socket so as to connect the two binding posts and is consequently a shunt to the lamp; when a lamp burns out the entire current must pass through the shunt the resistance of which immediately falls, by the action of the heat upon the compound, to practically nothing; and the compound being softened by the heat, the metal pieces are brought into direct contact with each other by the action of a powerful spring, so that, actually, double provision is made against opening the circuit.

"Contacts" which have acted are replaced by new ones just as burned out lamps are replaced by new lamps but they can at very small expense be prepared for use again. The "contact" besides serving as the cut-out is also, excepting for lamps of high candle power, the "off and on" key to the lamp.

The socket as now used has been carefully worked out at the Company's factory in Boston and it presents many entirely new and interesting features. As it carries both the cut-out and lamp and also embraces certain short circuiting devices, it is known to the trade as the "combination-socket"; its outside parts are of insulating material and the inside parts are strong and seem to be very thoroughly put together; it is so arranged as to prevent the circuit from being opened, either intentionally or accidentally, by the removal of either the lamp or the "contact"; its construction is clearly shown by Fig. 2, which represents the socket with the contact and cap removed; each binding post is connected to the other by means of two metal pieces which are actuated by springs so that there are two or more, properly speaking, four short circuits between the binding posts; when the lamp is inserted two of these short circuits are broken and the current flows through the remaining two until the "contact" is inserted and turned to the "on" position which destroys the last two short circuits and causes the current to pass through the lamp. When the lamp is removed a double short circuit between the binding posts is immediately formed and another double short circuit is similarly formed whenever the "contact" (cut-out) is taken from the socket.

As the socket is for use on circuits carrying as many as ten amperes of current, all its metal parts have been made unusually thick and heavy to protect them against undue heating.

In Fig. 3, the "Combination-Socket" is seen complete, the "contact" being in the "on" position.

The lamp, Fig. 4, has also been especially constructed, and it presents several points of difference from any we have before seen.

FIG. 1.

The base of the lamp is of the same insulating material as the outside parts of the socket, and its terminals of heavy brass are cast into the base and so held very securely in position; the leading-in wires are very ingeniously secured to the terminals by means of diminutive set-screws.

FIG. 2.

FIG. 3.

The lamps are of 25, 50 and 100 candle power respectively, and are made for many different currents ranging from five to ten amperes.

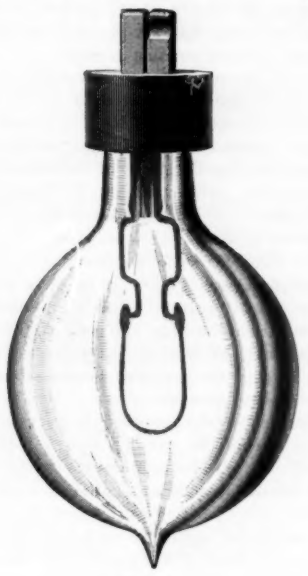


FIG. 4.

FIG. 5.

THE BERNSTEIN SERIES INCANDESCENT LIGHTING.

The complete fixture, with lamp and shade, is shown in Fig. 5.

The Company has prepared for its customers full illustrated directions for wiring and using its lamps and fittings, and states that it is now perfecting the various parts necessary for complete street lighting outfits.

The Geneva Non-Magnetic Watch Company are meeting with a magnificent patronage, not only from electrical workers generally but from the time-wearing public as a whole. The difficulty the Company now has is in filling orders. A new style watch containing the Pailliard improvements in all respects, that can be sold for a price ranging from $12 to $18 is to be brought out at once and will supply a demand that this Company has not heretofore been able to fill. The Non-Magnetic people are well pleased over the number of gold medals they won against all competitors while in Geneva.

—— W. H. Ruffin, of Danville, Va., is negotiating to put in an electric light plant.

—— Hiram Robbins is to purchase an outfit for an electric light plant of fifty 16 candle-power lights for the town of Little Rock, Ark.

—— Cecil C. Pool, of Lynchburg, Va., will erect an electric light plant with a capacity of one hundred 30 candle-power lights.

—— The primary battery exploiters have arrived in Chattanooga, Tenn. The usual story is presented, but it is to be hoped that by this time the public is well enough informed not to believe all that is told it in regard to the wonderful economy of this method of lighting. Economy is just what it lacks.

—— The Cape May, N. J., City Council has awarded a contract to the Franklin Electric Light Company for the lighting of the streets for three years. The main contract provides for 50 arc lights throughout the city, at the rate of $3,900, $3,800 and $3,600 for each year, respectively. The extra lights for the beach drive during the summer will be furnished at 35 cents each per night. It is stated that the company will furnish the incandescent light to private consumers.

ELECTRIC LIGHT NEWS

—— Penacook, N. H., is to have an electric light plant. H. F. Brown is one of the parties interested.

—— The electric light subscription in St. Johnsbury, Vt., is working up to the requisite $20,000 capital required.

—— The factory of The N. Ward Company, Spectacle Island, Boston Harbor, is to have a Loomis plant of incandescent lights.

—— The Schuyler Company has been awarded the contract for lighting Hagerstown, Md. There were thirteen applicants for the work.

—— The Newburyport Mass. Electric Light and Power Company have received their new 80-horse power engine, and also two new dynamos of 30 arc lights each. Engines and dynamos will be placed in position immediately.

—— A committee of the town of Pittsfield, Me., are engaged in selecting a system of lighting. They will commence with 300 16 candle power incandescent lights. The location of the plant will be decided as soon as practicable.

—— The business houses in Rutland, Vt., are introducing the electric light into their stores, and the company is kept busy in this direction. The Rochester clothing company's store is the latest one equipped with the arc system.

—— The electric lighting system is to be introduced into the Charleston, Mass., Navy Yard, and the dynamos, wires, lamps and other appurtenances to be used, will be bought outright by the Government. The shops and streets will be illuminated with arc lamps and the offices and residences by the Edison incandescent system. It is expected that the system will be in full running order before the next winter. By this move the Government will probably save thousands of dollars annually.

—— The Common Council of Madison, Wis., passed an ordinance granting to George W. Gilman, J. C. Woodward and John W. Hudson the franchise to construct and operate a system of electric lights. The parties represent the Thomson-Houston Electric Light Company. The ordinance stipulates that the system must be put in operation within sixty days of the passage of the same, and that within a period of five years the company shall not transfer its rights to any corporation or company aside from the city of Madison.

—— The City Council of Newport, R. I., is considering the question of adopting the electric light for all city lighting. The proposition, if adopted, will do away with all present electric, gas and naphtha street lights and will reduce the cost of lighting the city to about $16,000 a year. The proposition is for the lighting of the streets for eighteen months to the end of 1889. The incandescent light will be used entirely throughout the city, seven hundred and fifty lights being put in operation in all. The lights will be of 30 candle power.

—— Lieut.-Commander Bradford and Lieut. Veeder of the steamer Chicago, have been at work for two weeks putting a complete outfit of electric lights into the new cruiser. The Chicago will be ready for commission as flag ship of the European squadron when her battery is ready. She has now 428 Edison incandescent lights, which are distributed in every part of the vessel, so that oil lamps and candles may be dispensed with, and the danger from fire practically nullified. To insure against fire from water coming in contact with exposed wire next to wood-work, the wires are covered with tube and thin sheet lead. The side lights and the running lights are of fifty and thirty-two candle power. The pilot house is also provided with electric lights.

ELECTRICAL AND SCIENTIFIC

** An old locomotive engineer says that a cinder can be removed from the eye by rubbing the uninjured eye, instead of the one containing the particle. He has tried it times without number and always found it successful.

** The Novelty Aerial Ship Company has been organized to transport passengers through the air. The trial trip is to be between Jersey City and Brooklyn. The long head of the inventor is shown in the fact that he first offers to carry passengers out of New Jersey.

** The Edson Pressure Recording Gauge which was exhibited by Mr. Edson at the recent Convention of the American Water Works Association, at Cleveland, O., was purchased by the proprietor of "The Hollenden," where the meeting was held, and now occupies a conspicuous position in the general office of the hotel.

** But perhaps one of the most comforting properties of electricity, is its faculty of determining without doubt, whether the person to whom it is applied is dead or living. Cases of premature burial are extremely rare, but frequent enough, nevertheless, to excite horror and apprehension. Within one to six hours after the cessation of life, the muscles loose the power of contracting when a current of electricity is passed through them, so that in doubtful cases the proof of death can be readily obtained by such a test.

** Considerable local excitement has been caused by the discovery of electricity in the water works at Lebanon, Mo. Some time ago, during the dry weather, the 'Frisco company put a pump in the well, but before connection was made with their tank, water was plenty and the well was abandoned. An attempt was made to remove the pump, when it was found that some part of the pump was fast to the piping, which extends down about 300 feet. It was also found that by the application of small steel articles, that the pipe is highly magnetic, and steel adheres to it. The well is 1,200 feet deep, and has 900 feet of water in it. It has filled in and been drilled out three times.

** A dispatch from Atlanta, says: "I was talking to Mr. Chamberlain the other day," says Judge Tompkins, "who is a practical man of our coal and iron company. He made a startling suggestion. He said the time may come when all the iron mines of this country will be abandoned. The most generally diffused metal on earth is aluminum. It is found almost invariably in clay, especially in red clay. It is now extracted from clay by a very expensive and tedious process, at a cost of more than $500 a ton. Some one will invent a process for getting aluminum out of clay by a rapid and cheap process. Then farewell to iron mines. Aluminum has three times the strength of steel and only one-third the weight. This makes it, of course, the most valuable of metals. It was only discovered in 1828. It is bright and it never tarnishes. Louis Napoleon offered $6,000 for a process for extracting it from clay, and two small bars of aluminum were presented to him by a French chemist as the result. It was immensely expensive, but Napoleon had works established for extracting it, and he used it as a substitute for the silver eagles that were borne above the armies of France. It has all the beauty of silver, is more lasting, stainless and has one-fourth the weight of silver. The eagles of France are thus made more resplendent, more enduring and 75 per cent. lighter in weight. Look out for aluminum. Some one will yet invent a process for digging up common dirt and extracting therefrom the best of all metals."

Testing Electric Light Circuits.

ADDRESS BEFORE THE CHICAGO ELECTRIC CLUB, BY C. H. RUDD.

I come to-night to lay before you a plan for testing arc light circuits when in action to see if they are free of ground. I will first indicate the nature of my subject by diagram, and then follow with such unfolding of principle as I am able to make.

A and *A'* are binding posts connected one to either side of the dynamo *L*. *B* is a grounded posts for trial tests. *C*, cord and plug. *D* and *D'* are binding posts connected together by a piece of No. 36 German silver wire. *E* is a spool of No. 36 German silver wire. *F* is a hand telephone. *G* is a two-way switch. *H* is a battery for use when the dynamo is not running. *K* is a small condenser. When the two-way switch lever stands to the left, the circuit may be traced from the plug and cord, *C*, through the German silver wire between posts *D* and *D'*; through the hand telephone, switch and condenser to ground.

The dynamo is supposed to be running, and the engineer wishing to test, puts the telephone to his ear and touches the plug to first one and then the other of posts *A* and *A'*. If the circuit is free from escape, there will be no sound in the telephone. If there *is* escape, there will be more or less buzzing sound, according to the electrical distance which the escape is from the testing point. With the two-way switch lever to the right, the battery is substituted for the condenser, and the apparatus is ready to test when the dynamo is not running. In the latter case, an escape is indicated by a sharp click in the telephone. The fine wire is put in circuit so that it may burn off in case the condenser breaks down. This apparatus packed in a box serves for testing from lamp to lamp when the dynamo is running. The battery need not be included in the portable outfit.

Having listened to the description of the manner in which the testing device works, you wait for the presentation of the principles involved. The task laid upon me is not without its pleasures. I have enjoyed the study which has been necessary to a proper understanding of the system, and hope that the points which have interested me will impress you in a similar manner. "Potential" is my first topic, and as I name it you think of efforts put forth in your earlier days to clear the subject of its mysteries. In his third edition of "Electricity and Magnetism," page 30, paragraph 4, Jenkin says: "In considering the potential at a point, it is not necessary to conceive of the presence of any electricity at that point." If we accept and would understand this statement, we must rid our minds of the idea that Potential and Electro-Motive Force are interchangeable terms. They are not interchangeable terms, but express two conditions in nature. These two conditions are intimately related. They are associated together in all forms of electrical phenomena just as the strength of the boiler is associated with the power of the steam in producing action in the steam engine; or as the rock and water that go to make a water-fall are associated together in driving the water-wheel.

Perhaps I can strike more directly at the point if I use an electrical condenser to aid me. I will ask you to make a mental picture of such a condenser and consider its action. You see the two plates with the insulator between. The value of the insulating material as an insulator determines the time during which the condenser will hold a charge. Therefore the insulator in a condenser is associated with the charge in producing the phenomena connected with the charged condenser.

If either plate of a condenser be assumed to be at zero potential, the other will be higher by an amount in direct proportion to the degree of insulation between the plates. I feel justified in saying that potential is a condition under which electricity is confined or held at a density above the normal, and this condition exists without the presence of any electricity. Electricity under pressure reveals potential, but does not create it. If one pole of a battery should be described as being at zero potential, the other pole might be said to have a potential of infinite light because there is no flow of current backward through the battery. The remarks which I have made about a battery may be applied to the armature of a dynamo when in action. When I speak of two points as having an infinite difference in potential, as in the case of the battery, I simply mean that an infinite electro motive force in the battery would be resisted and kept from producing a backward movement of current through the battery. If a point in an electric light circuit, outside of the armature, be called zero potential, every other point outside of the armature will be above it by an amount in direct proportion to the resistance between the points. If two of these points be connected together by a conductor outside of

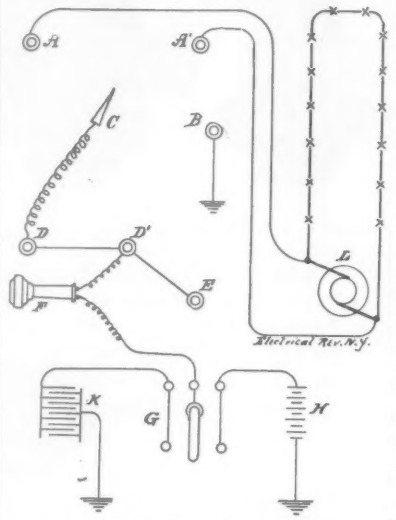


DIAGRAM OF TEST OF ELECTRIC LIGHT CIRCUITS.

the circuit, the outside conductor will carry a current the amount of which will be determined by the relation which its resistance bears to the resistance between the points so connected, according to the laws governing the action of derived currents. I have stated what seem to me to be facts and will try to make the use of the facts plain further on.

Another topic of which I wish to speak is the part which the earth plays in electrical matters. I will introduce the subject by asking the question: "Is the earth a conductor or a reservoir?" This question was once discussed with a good degree of earnestness. We are apt to be a little superstitious as we think of the globe on which we live. For instance, we speak of the attraction of the earth and forget that attraction is not a property exclusively of the earth, but a property of all matter so far as is known. Let us assume for a moment that the earth is a reservoir for electricity, and we desire to consider what takes place when we use it for a "return."

We must use conductors with good large surface to get contact with the ground, and the ground itself must be possessed of conductivity at least in the immediate neighborhood of the contact. Who will say where the conductor action ceases and the reservoir action begins? Have we not been ascribing to the earth electrical properties which do not belong to it in any mysterious sense? And are we not forced to admit that it is simply a great conductor? You may ask, "Does the same electricity which enters the ground at one end of a telegraph line, emerge at the other and join its mate?" In reply to this question, it is but fair to say that whatever action takes place in a metallic circuit, in the sense in which we speak, takes place also in a circuit of which the ground forms a part. Does electricity seek the earth? I reply, no. Electricity seeks an equilibrium, and moves in whatever direction it can, to attain this end. If a plate at high potential be charged with electricity and then connected to another plate of like potential but without charge, the charge upon the first plate will spread itself upon both, and the sum of the two quantities will be equal to the quantity upon the first plate. The idea that electricity seeks the earth has led some to suppose that the current in electric light circuits is constantly trying to escape. This is a mistake and *because* it is a mistake, the testing apparatus which we consider to-night, finds useful employment, when a light circuit is grounded at one point, then a current moving in the circuit tries to escape at all points but the one that is grounded. If an observer should take a portable set of testing apparatus and move along the circuit from lamp to lamp testing for the disposition to escape, he would find that the disposition would grow less and less until he reached the grounded point, when it would cease. The reason why the current in a well insulated light circuit is so entirely satisfied to stay at home is this: The dynamo in the circuit creates two conditions, equal in amount and opposite in character. These conditions meet and neutralize each other, and as they have plenty of room in which to do their work, there is no occasion for them to reach out when the conditions tending to electrical action are fully met within a circuit. It might be said that there is no relation existing between the circuit and the earth, but let one point in the circuit be grounded, then a relation springs up at once. The grounded point is at the potential of the earth, and every other point is at a higher potential; the light being in direct proportion to the electrical distance from the grounded point. I might speak of this in another way, viz: The earth being a conductor, if it is connected to a light circuit at any point, it then brings into action whatever connection it may have with other points, and carries current according to the relation which its resistance bears to the resistance between the points connected, after the manner of derived circuits generally. I will now refer to the action of the condenser in the testing system. The service rendered by the condenser is that of a cut-off. It takes current enough to indicate the condition of the circuit and no more. The amount of current that will pass through one microfarad, even under high pressure, is small. This will be understood by referring to the manner in which any condenser acts. If a circuit carrying a 1 ampere current should be opened, and a condenser of 1 microfarad be put into the break, the circuit would appear to be closed for the one millionth part of a second, if the charge could enter the condenser at a uniform rate of speed; but the charge enters at a rapidly diminishing rate of speed, on account of the rapid rise of electro-motive force in the condenser, hence the work done in the circuit described must be very small. It would require a condenser of enormous capacity, put into the circuit spoken of, to raise the current fully up to one ampere for an appreciable length of time. If the electro-motive force were one volt, the resistance one ohm, and the condenser capacity one billion microfarads, the current would lose about one-tenth of one per cent. in the first second. The telephone receiver plays an important part in the testing apparatus, on account of its extreme sensitiveness. Illustrations of this point are many. I will mention one which I witnessed. I stretched a wire 200 feet long upon wooden stakes, 125 feet from a telegraph line. One end of the short wire was open, the other end being connected to a hand telephone, and thence to ground. A vibratory signal made upon the telegraph wire at a point 40 miles distant, was distinctly read upon the telephone. The small amount of energy reaching the telephone in this case reminds me of a prescription said to have been made by a homeopathic physician. The prescription runs thus:

Take a little aconite,
(Less would be better),
Put it with care into Lake Superior;
Stir the mixture well
Lest it prove inferior;
Dose, half a drop in water.

Thermo-Electric Couples.—Some foreign papers state that a new thermo-electric couple, having an E. M. F. as high as 0.18 volt, and a resistance as low as 0.009 ohm, has been constructed by M. Heimel. The importance of these figures becomes evident when it is pointed out that the thermo-electric couple best known in England, that of Clamond, has an E. M. F. of only 0.02 volt with a resistance of 0.02 ohm.

ELECTRICAL PATENTS

(Copies of any Patents in the following List will be sent to any address on receipt of twenty-five cents.)

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING APRIL 24, 1888.

381,531 Telephone receiver, William H. Collins, Chicago, Ills., assignor of one-half to Jacob Kirkner, New York, N. Y., and Robert Bines, Chicago, Ills.

381,542 Solution for voltaic batteries, Charles E. Egan, Columbus, Ohio, assignor by direct and mesne assignments, to William Y. Miles and S. W. Smith, both of same place.

381,555 and 381,556 Electric railway, Rudolph M. Hunter, Philadelphia, Pa., assignor to the Electric Car Company of America, same place.

381,568 Steam dynamo electric machine, Richard H. Mather, Windsor, Conn.

381,576 Electric signaling apparatus, Myron W. Parrish, Detroit, Mich., assignor to the Parrish Bros. and Peck Electrical Company, same place.

381,585 Trap for electrical railway conduits, Wm. M. Schlesinger, Philadelphia, Pa.

381,636 Armature for dynamos, Moritz A. Muller, Newark, N. J., assignor to the United States Electric Lighting Company, New York, N. Y.

381,650 Electric motor for railways, Sidney H. Short, Denver, Colo., assignor to the United States Electric Company, same place.

381,653 Conduit, James Steel, Paterson, N. J.

381,693 Electric alarm for ships compasses, Augustus Gross, Newcastle, New South Wales.

381,700 Armature for Dynamos, John F. Kelly, New York, N. Y., assignor to the United States Electric Lighting Company, same place.

381,709 Annunciator and signaling apparatus, Morris Martin, Malden, assignor of one-half to Chas. Follen Adams, Boston, Mass.

381,725 Electric door opener, John Schneider, New York, N. Y.

381,736 Electric indicator, Edward Weston, Newark, N. J.

381,738 Telegraphic signaling apparatus, James B. Willis, Portsmouth, County of Hauts, England.

381,764 Telegraphy, Patrick B. Delany, New York, N. Y.

381,765 Electric bell, Constant F. de Redon, New York, N. Y., assignor to Pearce & Jones, same place.

381,768 Regulation of electric motors, Stephen D. Field, Yonkers, N. Y.

381,772 Electric annunciator, John Geary, Philadelphia, Pa.

381,780 Electrical measurement apparatus, Hammond V. Hayes, Cambridge, Mass.

381,789 Dynamo electric machine and motor, Moritz Immisch, London, County of Middlesex, England.

381,794 Transformation and distribution of electric energy, Rankin Kennedy, Glasgow, County of Lanark, Scotland, assignor of one-half to Robert Dick, same place.

381,815 Heating by electricity. 381,816 Electric heating apparatus for railway cars. 381,817 Electric heating system. 381,818 Method of electro-chemical heating. 381,819 Heating railway cars by electro-chemical means, Elias E. Ries, Baltimore, Md., assignor of one-half to Albert H. Henderson, same place.

381,823 Electrical bell or mechanical striker, John H. Bickford, Salem, Mass.

381,839 Dynamo telegraphy, Francis N. Jones, New York, N. Y.

381,852 Electric fire and burglar alarm, Andrew Schuchman, Springfield, Ill.

381,856 Electrical apparatus, Clarence C. Sibley, New York, N. Y., assignor to the New Haven Clock Company, New Haven, Ct.

381,866 Electrical method of automatically controlling the supply of water or gas, Leopold Weil, New York, N. Y.

381,896 Automatic fire alarm system, John Young, Chicago, Ills.

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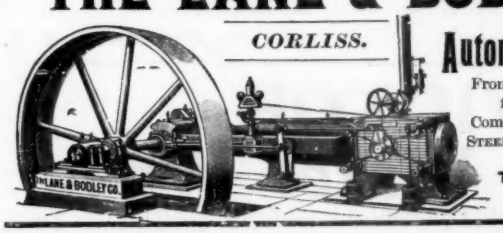

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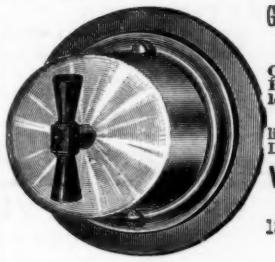

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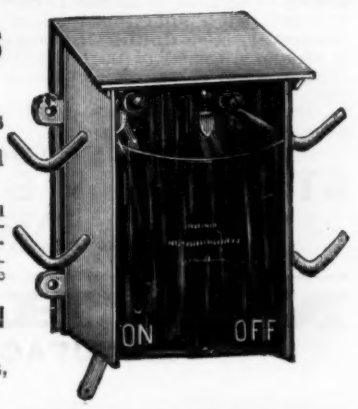

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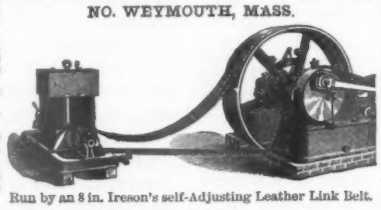

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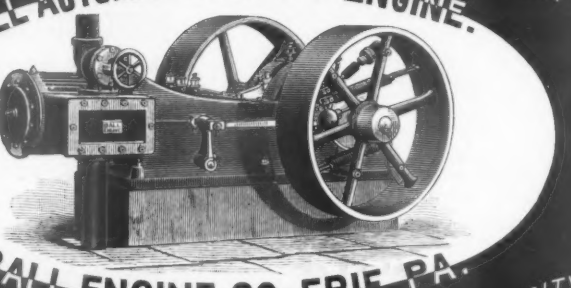

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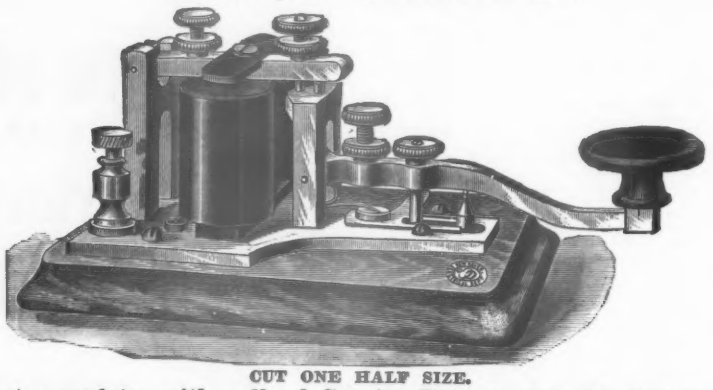

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